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Modern Cosmogonies.

XIII.—Life as the Outcome.*

By MISS AGNES M. CLERKE, *Hon. Member R.A.S.*

THE making of world's, we are assured, was not purposeless; and its most obvious purpose to our minds is the preparation of suitable abodes for organic life. No other seems of comparable importance; no other, indeed, comes within the full grasp of our apprehensive intelligence. Its limitations, however, must not be forgotten. The human standpoint is not the only one from which the sum of things may be surveyed; and although we be unable to quit it, we can still admit that the view obtainable from it is probably not all-embracing. We only, then, know with certainty that the end which appears to us supreme has, in one case, been successfully attained; how far it was sought to be compassed elsewhere must always remain a matter of speculation.

On our own globe, the presence of life is none the less mysterious for being profuse and familiar. We can trace the strange history of its slow unfolding; but the secret of its initiation baffles our utmost scrutiny. The cooled rind of a once molten globe serves as the stage for the drama; beneath it, primeval heat still reigns. Temperature rises steadily with descent into the interior of the earth; at a depth of about two miles, it must reach the boiling-point of water at the sea-level. This temperature, which is absolutely prohibitive of vitality, was formerly, beyond question, that of the surface. At some long-past epoch, accordingly, our future oceans hung suspended as a prodigious envelope of vapour above a hot crust of slag and lava; our teeming planet lay barren; it harboured no promise, no potency, no visible possibility of life.

So it should have remained had the law of continuity been rigidly enforced; but there came a time for a new beginning, and a new beginning was made. A momentous alteration took place; inert nature was quickened; what had been sterile became all at once fruitful; an immeasurable gulf was bridged, and movement was started along an endless line of advance. That the advance was set on foot and directed by an intelligent Will is the only inference derivable from a rational survey of the known facts.

* *Continued from February.*

Life can be studied in its manifestations, not in itself. Attempts to define it have served only to show our inability to "lift the painted veil." We can, however, see that its presence is attended by characteristic effects, brought about in harmony with the laws or inorganic nature, although not in blind submission to them. Their operation is somehow restrained, and appears to be subtly though securely guided towards determinate ends prescribed by the vital needs of each animal or plant. This modifying principle unmistakably regulates the economy of every living organism; the cessation of its activity means death.

Science has made no progress towards solving the enigma of vitality. Its evasiveness becomes, on the contrary, more apparent as enquiry is rendered more exact. Under a laxer discipline of thought the contrast between life and death seemed less glaring. It was easily taken for granted that creeping things were engendered by corruption, aid being invoked if required from the *virtus coelestis* of the eighth sphere. Thus, the birth of mice from damp earth was, in the ninth century, held to be signified by the word *mus* (= hu-mus);* and Van Helmont, at the height of the revival of learning, published without misgiving a recipe for the creation of the same animals.† Yet there was already better knowledge to be had for the asking; and Francesco Redi, in 1668, crystallised Harvey's opinion in the celebrated maxim, "*Omne vivum ex vivo.*" Its truth is incontrovertible. Challenged and tested again and again, it has as often been vindicated, and may now be said to stand outside the range of debate. "That life is an antecedent to life," Lord Kelvin declared in 1871, "seems to me as sure a teaching of science as the law of gravitation."‡

But the succession is not easy to start within the terms of a strictly uniformitarian convention. The expedient is tempting, if scarcely satisfactory, of demanding from the past what we dare not claim from the present. Two and a half millenniums ago, it was already in vogue. Herodotus dismisses a genealogical embarrassment with the remark; γένοιτο δ'ἀν πᾶν ἐν τῷ μακρῷ χρόνῳ, which may be freely translated, "In the long run of time, anything may happen." Conditions, we are apt to think, may have been more elastic long ago. The proven impossibility of to-day becomes vaguely thinkable seen through the mist of uncounted yesterdays. "If it were given to me," Professor Huxley said,¶ "to look beyond the abyss of geologically recorded time to the still more remote period when the earth was passing through physical and chemical conditions which it can no more see

* Hewitt, *Problems of the Age*, p. 105.

† Pasteur, *Annales de Chimie et de Physique*, *t.* XLIV., p. 6, 1862.

‡ *Popular Lectures and Addresses*, Vol. II., p. 198.

¶ *Report Brit. Ass.*, 1870, p. 84.

again than a man can recall his infancy, I should expect to be a witness of the evolution of living protoplasm from non-living matter." To these first vital compounds, he attributed a fungoid nature and mode of growth; and the choice deprived his speculation of any plausibility that might otherwise have belonged to it. Fungi are not self-supporting; they cannot supply themselves with nourishment from the raw materials of the mineral world; they depend upon the hospitality of differently organised beings. They were then certainly not among "the first mercies of nature." Mr. Herbert Spencer, too, was inclined to regard spontaneous generation as a superannuated process. The leap from the non-vital to the vital, now admittedly impracticable, might have been taken, it seemed to him, when "the heat of the earth's surface was falling through those ranges of temperature at which the higher organic compounds are unstable." But the "reason why" is to seek. A sterilised solution is precisely one which has cooled from a high thermal grade; a baked brick is similarly circumstanced. Why should the appearance of life in primeval times have been favoured by a state of things fatal to it here and now?

The essence of the biological crux resides in "protoplasm." The word was coined by Von Mohl in 1846 with the object of emphasising the importance of the substance signified, which indeed forms the bulk of every organism, animal and vegetable, man, mushroom, and amœba. Huxley rightly termed it "the physical basis of life," adding, however, the infelicitous conjecture that its production might have been one of the lucky hits of nature. It would have been a hit of incalculable moment, but of incalculable improbability. "Odds beyond arithmetic" were against that particular throw coming out of the Lucretian dice-box. The "primal slime" (to use Oken's phrase) is composed of oxygen, nitrogen, hydrogen, and carbon, with minute percentages of phosphates and other salts. But these constituents are put together in a highly artificial manner. Eight or nine hundred elementary atoms, in fact, go to the making of one molecule of protoplasm, forming a structure of extreme complexity, most delicately balanced, and eminently unstable. It results, accordingly, from the employment of specially directed forces, and stores, for the benefit of the producing organism, the energy expended in its construction. Left to itself, it promptly goes to pieces, and yields back its component particles to their native inorganic sphere. The laws there ruling are in truth adverse to the existence of protoplasm; abandoned to their unmitigated action, it perishes. We should then as reasonably suppose that in the geological past, rivers flowed uphill, as that inorganic nature stumbled blindly upon this wonderful postulate and product of life.

Professor Huxley affirmed life to be "a property of protoplasm," the inevitable outcome of "the nature and disposition of its molecules." And he sought to cover the absurdity of the dictum by claiming as analogous a case wholly disparate. Water, he argued, has qualities totally unlike those of oxygen or hydrogen; and protoplasm may similarly, by mere intricacy of arrangement, and the evoking of latent affinities, become endowed with the transcendant powers connected with animated existence. "What better philosophical status, then," he exclaimed, "has *vitality* than *aquosity*?"* "True," he added, "protoplasm can only be generated by protoplasm, in a manner that evades our intelligence; but does any body quite comprehend the *modus operandi* of an electric spark which traverses a mixture of oxygen and hydrogen?" The illustration, however, is inapt. The electric spark fulfils no constructive function. It simply agitates the molecules so as to bring their native affinities into play. It acts like a mechanical blow on dynamite. Further, water is a stable compound, because its formation is attended by loss of energy, and the descent to a lower plane gives permanence to its occupation. But protoplasm is, in this respect, the antitype of water. It needs force for its composition; water needs force for its decomposition. Protoplasm needs force plus a suitable apparatus; it can be turned out only by an artfully adapted machine with a head of steam on. It is thus continually manufactured by plants under the stimulus of light. They supply the apparatus, sunbeams the energy. If the supply is cut off, the machinery comes to a halt; protoplasm ceases to be generated; the plant dies of inanition.

Many German biologists find themselves compelled by the impossibility of explaining vital activities in terms of chemistry or physics, to associate protoplasm with some kind of psychical activity.* Individuality, at any rate, implies an ultra-material principle; and it asserts itself at the very base of the animal creation. An amœba is the simplest of living beings. Formerly called the "Proteus animalcule," it is "everything in turn, and nothing long." It can be round or radiated, spherical or lenticular, as momentary convenience prescribes. Organs it has none; its limbs are conspicuous by absence; it is "sans everything" that belongs to the ordinary outfit of an animated creature. Yet such-like nucleated globules of protoplasm have flourished exuberantly during countless ages. Adaptability ensured survival. An amœba is at home in almost any environment. What it has not ready-made, it can supply at a moment's notice. Out of any part of its substance it can improvise feelers and tentacles for the capture of its prey, as well as a stomach for its digestion; and thus effectively goes through the full round of animal economy. Some varieties, too, are noted builders. These Foraminifera have the faculty of secreting carbonate of lime from sea-water; and with it they construct fairy dwellings, perforated in all directions to allow of the protrusion of exploratory filaments. Fossil-chambered shells of this type are extraordinarily abundant. Their dense conglomeration in the chalk elicited Buffon's exclamation that "the very dust had been alive!"† The *calcaire grossier* of which Paris is built mainly consists of them; and to this day, in oceanic depths, the materials of future capitals are in course of preparation by the monumental industry of these unpretending organisms.

Such as they are, they maintain an incomparable status. Incomparable, for instance, as regards the water in which they float. An amœba incarnates a purpose; it embodies a spark of individual existence, unconsciously swaying the powers of inorganic nature towards the ends of its own well-being. The subordination is most real, though profoundly mysterious. In the organic and the inorganic worlds, the same laws hold good; the same ultimate atoms exert their preferences in each; in neither is an uncaused effect possible. A bullet can no more be fired from a gun that has no charge than a man can lift a finger without a corresponding outlay of food-products. Accordingly, while plants store and animals expend energy, plants and animals are equally incompetent for

* *Collected Essays*, Vol. I., p. 153.

* Neumeister, *Betrachtungen über das Wesen der Lebenserscheinungen*, 1903.

† Owen, *Palæontology*, pp. 11, 14.

its origination. What they can do is to appropriate and specifically apply it; and herein resides the essence of life. "It would seem," Sir George Stokes wrote in 1893,* "to be something of the nature of a directing power, not counteracting the action of the physical forces, but guiding them into a determined channel." What the power is in itself it would be futile to seek to define. We are only sure of its being extra-physical. Matter cannot evolve a principle which disposes of it as its master. Evolution means only the unfolding into self-evidence of something already obscurely present. The "latent process" (to use a Baconian term) of the hatching of an egg is typical and instructive. Yet it is not the less recondite for being familiar. A concourse of suns, indeed, fails to impress us with the unutterable wonder of the "flower in the crannied wall" apostrophised by the last great poet of the nineteenth century.

The two wide kingdoms of life lack a "scientific frontier." The boundary-line is ill-marked and irregular. So much so that a few naturalists have set up a neutral zone, or no man's land, inhabited by creatures of mixed or uncertain nature, by plant-animals, or zoophytes in the literal sense of the word. But the expedient avails to shelter ignorance rather than to advance knowledge. For it seems probable that there is no organism so imperfectly characterised as to be genuinely incapable of giving a categorical answer to the question, "Under which king, Bezonian?" Fungi might, perhaps, on a superficial view be taken for hybrids. They share the nature of animals so far as to be unable to elaborate their own food, while appearing in other respects to be authentic vegetables. They are, in fact, parasites and scavengers. Not the smallest reason exists for supposing them to constitute a genetic link between the two chief hierarchies. These are, in all likelihood, fundamentally distinct. Only by a gratuitous hypothesis can they be credited with a common ancestor. Each seeks a different kind of perfection; their ideals, so to speak, follow divergent tracks. That the tracks were marked out from the beginning, may be safely affirmed; and this implies radical separation. Plants came first, since animals pre-suppose and imperatively require them; the antecedence having quite possibly been by a vast interval of time. On this point, geological evidence, though inconclusive, is suggestive. The Laurentian beds, which are among the very earliest stratified formations, contain no recognisable fossils. They were once supposed to enshrine the remains of a lowly organism dubbed *Eozōon Canadense;* but the markings that simulated animal forms are now known to be of mineral origin. Laurentian graphite, on the other hand, occurs plentifully; and graphite may be described as coal at a more advanced stage of mineralisation. Such deposits, we are led to believe, consist of altered vegetable substances; and it seems to follow that these hoary rocks are the burying ground of a profuse succession of virgin-forests. That they flourished beneath the sea—were in fact composed of algæ—was the opinion of Professor Prestwich; † and it is not easily gainsaid.

Primitive animal life was unquestionably marine, and the Huronian strata, which overlay the Laurentian, afford traces of it in a few sponge-spicules, the cast of an annelid, and such-like scanty leavings. Higher up, the Cambrian series swarms with oceanic invertebrates; fishes, the first type of vertebrates, came upon the scene in Silurian times; and so, by a various and surprising progression, life advanced through the ages, until the ascending sequence culminated with a being cast in a diviner mould, who walks the earth, even now, with face uplifted to the stars.

> "Natus homo est; illum mundi melioris origo
> Finxit in effigiem moderantûm cuncta deorum."

In the vegetable kingdom, the vital law of development has wrought with less conspicuous effect. The superiority of recent to ancient floras is more significant than striking. A tree-fern or a sigillaria bears comparison with an oak much better than a trilobite or a plesiosaurus with an eagle, horse, or lion. The geological variations of plants, however, have unmistakably tended to make them more serviceable to man—more serviceable to his material needs, and also more gratifying to his æsthetic instincts. For him, flower petals were painted, and perfumes distilled; for him, the grasses of the prairie laid up stores of sustaining nutriment; in preparation for his advent, choice fruits ripened and reddened under Tertiary sunshine; while the barren and sombre vegetation of the Carboniferous epoch had already done its part by dying down into seams of coal for the eventual supply of power for human industry and warmth for human comfort.

It would be an abuse of our readers' patience to discuss the futile conjecture of an extra-terrestrial origin for life on our globe. The agency, in this connection, of germ-laden aërolites was first invoked by Richter of Dresden; and Lord Kelvin gave currency to the notion by an incidental reference to it in 1871 from the Presidential Chair of the British Association. Its adoption would oblige us to regard the denizens of our planet, fauna and flora alike, as salvage from the wreck of some unknown world in space. *Credat Judæus Apella.* To our minds, "all the fables of the legend" appear more credible than the prenatal history of the primal organism implied by this "wild surmise." Inquiry into the nature of the supposed organism serves to draw closer the web of embarrassment. The remarkable aridity of meteorites excludes the possibility of its having been of aquatic habitat. Members of the fungoid order are unsuited to act as pioneers, owing to their helplessness in the matter of commissariat; and the spores of lichens or mosses could scarcely be expected to survive the vicissitudes of such a journey as they must have performed if meteor-borne to terrestrial shores. The immigration hypothesis, moreover, even if it were plausible, could not be made useful. Difficulties do not vanish on being pushed into a corner; the problem of life is as formidable in one world as in another; we should not expect to find it easier to square the circle in Mars than Deinostratos found it in Greece; matter, we are convinced, has no more psychical initiative in the system of Arcturus than can be ascribed to it in the system of the sun. Profitless conjectures may then be dismissed; they do not help us out of the slough of intellectual impotence.

This need not indeed be absolute. The determination to regard things mechanically alone renders them unintelligible. Science becomes unscientific when it refuses to be guided by experience; and we have the plainest testimony of consciousness to the working in ourselves of originative faculties independent of, and irrepressible by, physical agencies. Here we hold the clue to the labyrinth. The intimation conveyed is distinct of a Power outside nature, continually and inscrutably acting for order, elevation, and vivification.

* *Gifford Lectures*, p. 46.

† *Geology*, Vol. II., p. 22.

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Seeing Beneath the Waves.

By the late Rev. J. M. Bacon.

A curious controversy arose fifty years ago concerning the old fable of the "Dog and the Shadow," which opened up the subject of vision through water. On the one side Doctor Lardner maintained that the story, "handed down through so many ages, diffused through so many languages, and taught so universally in the nursery and the school," of a dog being able to see in water the reflection of himself and the meat in his mouth, "was a most gross optical blunder." On the other hand, critics were not found wanting who implied that the fable only represented a fact which ought to be familiar in all possessing ordinary observation. Thereupon the doctor retaliated with an experiment of his own, the futility of which should hardly need pointing out. He filled a basin with water, and, placing it near an open window, looked down upon it from a height of five feet, and saw no trace of his learned countenance therein.

Now, had the doctor simply gone to his water butt, the water within which we will suppose to be clear and not too near the top, and looked in, being careful also that sufficient side light illumined his features, he could have seen quite well enough to shave himself, or by holding a piece of printed paper downwards, not quite squarely but a little slanting, so as to catch the light, he could have had little difficulty in reading any ordinary type. Circumstances would have still further helped this experiment if a projecting roof or tree had overhung, so as to somewhat moderate the overwhelming light background of sky. From this it will be seen that experimenting with a white shallow basin near a window was a ridiculously unfair test of the truth of the old story, whereas were he to have stood over a deep dark overshadowed pool, which might reasonably have been presupposed, he would have found that the gross blunder was hardly in the fable.

But the controversy alluded to elicited some well-established physical facts which supply the argument of the present paper. It was first of all pointed out that the image of the banks of a lake or river viewed by an observer stationed at a considerable distance on the opposite side are very vivid, but become less so if the observer, being, we must suppose, in a boat, begins to approach nearer, the reason being that "when a ray falls so obliquely upon the surface of water as to make with the surface an angle of 15°, nearly a fourth of all the incident rays are reflected."

All this, however, can be stated more simply and intelligibly. All the world knows the difficulty of hitting any object under water with a shot gun. If fired nearly perpendicularly downwards over the side of a boat it is true that the shot will penetrate the water fairly steadily and truly, but it is otherwise if the gun has to be pointed in a slanting direction. In this case the shots enter the water reluctantly, taking only a shallow dive below, and in an extreme position the shots will not enter the water at all, but be reflected sheer off the surface.

It is practically the same with rays of light, and so it comes about that the image of a distant bank, being seen by rays which are very much aslant, and, therefore, very well reflected, is particularly vivid. And the converse of this is also true, thus—Imagine a sufficiently distinguishable object, say a fish's eye, three feet below clear water. This might be seen readily from a position directly overhead, but less distinctly if viewed at a slant angle, and actual experiment shows that all rays from the fish's eye which are so aslant as to reach the surface of the water beyond a radius of four feet never get out of the water at all, but are simply reflected back from the water's surface, which in this case acts as a perfect mirror. Thus an observer looking towards the fish from a position which is outside this limit will not see the fish, nor—*pace* certain fishermen I have known—will the fish see him. To put this fact beyond dispute let the following experiment be tried. Stand a tumbler nearly full of water on an open newspaper near the edge of a table, and then, placing your eye on a level with the table and six inches from the tumbler, look aslant upwards at the surface of the water. You then learn in a most convincing manner that the water's surface allows no outside rays to pass to your eye, but simply behaves as a mirror, revealing the print of the paper with the most perfect reflection.

We are now prepared to begin an enquiry into a curious and all-important phenomenon which it fell to the lot of the writer to be able to put to a crucial test. It needs no pointing out that in naval warfare, as being carried on at the present hour, there is nothing more deadly or more to be dreaded than the snares which are caused to lurk beneath the water—the mine, the torpedo, and the submarine. It is of paramount importance, therefore, to get, if by any means, some inkling of all that may lie at a moderate distance beneath the water line, and it has long been known that this may best be done by looking down into the water from a considerable height overhead. Even in peaceful navigation, when some danger, as, for instance, a shoal or sunken wreck or the like, is suspected of lying in a vessel's course, but cannot be seen from deck, then it is customary to send a man aloft, and the higher in reason that he can climb the further will his vision penetrate, and the better will his eye command a view of any submerged object. It was to determine the full extent to which this fact could be turned to account that the writer was commissioned under the auspices of the Admiralty to endeavour to obtain photographs of the sea bottom from a balloon. This feat was actually accomplished during an aërial sail over the Irish Sea from the Isle of Man, a voyage which became historical, and which resulted in the securing of a very remarkable photograph of the sea bed, showing varied rock and sand lying in 10 fathoms, that is 60 feet of water, and that water strongly ruffled after a week of boisterous weather.

Now it should be clear that the half of the secret of success in such an attempt has been already told. For if, say, a sunken vessel were lying in a few fathoms of water, and a man were looking down on it from a boat, and floating somewhere just over its middle part, then that middle part might be fairly well seen, but the more distant parts both fore and aft, being viewed at a slant angle, would probably be altogether invisible. If, however, the observer were to be let up a quarter of a mile into the sky, and to look down from there, all parts of the vessel would now lie practically perpendicularly below, and all would be equally well seen.

But in attempting to look beneath the water's surface at sea there is another obstacle to be reckoned with, and that is the usually troubled nature of that surface. For it is an everyday experience that objects which may

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be distinct enough below still water become indistinct or invisible if the water be disturbed. To obviate this difficulty it has become customary to make use of a very efficacious and useful instrument called a water telescope, which need be nothing more than a large tube, say a foot in diameter, and say six feet long, closed at one end with a sheet of glass. This end is now plunged beneath the troubled surface of broken water, and the observer applying his eye at the open end is at once able to see as clearly as if the water were unruffled, as, indeed, to his eye it now is.

But let us pass on to consider how it is that the surface of a transparent medium when broken up refuses to allow rays of light to have free passage. Let us take the case of a piece of clear glass, lying on a newspaper, the printed matter of which is then seen with perfect distinctness. But now commence pounding up the glass with a hammer and you find that the more completely the glass is broken up the more is the printed page obscured, and when at last the glass has become mere fine powder, it appears as a white mass like so much salt, and nothing is seen behind it. The fact is that light cannot penetrate the mass, because each ray as it passes from fragment to fragment glances hither and thither off a myriad minute surfaces, and thus wastes itself in a multitude of reflections. In scientific parlance the optical continuity is broken and the mass of powdered glass looks white simply because it only reflects back the white light of day. It would have appeared just as white had the glass been coloured, or even black. In the same way and for the same reason the froth on a glass of Guinness's stout, instead of being dark brown, appears white or nearly so.

We now grasp how it is that without a water telescope it is difficult to see through the surface of troubled water at close quarters, but the fact which we illustrate yet remains, namely, that when the eye is removed to a distance the distraction caused by the broken light largely disappears, and objects below are seen more clearly. Another example strictly analogous of the same sort of thing is afforded by either cloud or mist. Cloud is simply composed of particles of water mingled with particles of air, and though both separately are perfectly transparent, confused together

they form a mass which stops and reflects back the light, and for the same reason the illumined surfaces of clouds are white, but in actual fact the stoppage of light is not so complete as it appears, and a thin veil of mist will behave precisely as the broken water's edge, obliterating the view at short range, but to a more distant observer allowing objects to be seen through it with tolerable distinctness. Thus it often happens that a balloonist whose view of the outside world is wholly obscured by a shroud of thin mist can be quite clearly seen by those at a distance.

It should then be only in accordance with theory and known fact if the secrets of the sea depths, which hide themselves even from the trained eye of the sailor on board ship, should become revealed to an aëronaut who will poise himself in space overhead, say 10 times higher than the maintop.

It scarcely needs the further pointing out that there

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is always some of the light which, striking water, is neither reflected nor refracted, but simply scattered. It may sound strange, though it is perfectly true, that were it not for this scattering of light the surface of water would never be seen at all, even in broad day. It is just in the same way that the surface of a polished mirror cannot be seen except where there may be some scratch or smear upon it, and so true is this that in unfamiliar houses we sometimes surprise ourselves by walking up against walls which bear whole length mirrors in unexpected places. In the photograph of the sea bottom it will be noticed that the broken surface of the sea is seen all over the picture, notwithstanding the fact that through it all and below it all the sea floor is seen also.

Once below the surface, however, the ray travels far more readily than is generally supposed. The swimmer who, in diving, is accustomed to open his eyes under water is apt to imagine that very distinct vision is out of the question, but he forgets that the cause of this is due to the disturbance which his own motion is causing in the water. A fish, on the other hand, remaining motionless below, with an eye adapted to its surroundings, may see remarkably well. And on occasions it is brought home to the ordinary observer how well light may pass into clear water, and down to the depths below, and emerge again still in strength enough to ensure good vision. This beautiful phenomenon is particularly noticeable at the far end of some of the Norwegian Fjords, where the sea water has almost parted with its salt, and where no apparent tides disturb the pure and peaceful depths.

It is on looking down into these depths that one curious and not unimportant fact has to be thought of, namely, that they are much deeper than they seem to be. This follows of necessity from what has been already said, namely, that a ray whose path lies partly in air and partly in water takes but a shallow course through the water, a truth which is made perfectly apparent by simply dipping a stick or finger into a basin of water.

An amusing example of this illusion was forcibly impressed upon a friend of the writer, who went to take a morning dip in the swimming bath of an hotel. The hour being early, no one was about, and being long unfamiliar with baths of that description, he took his plunge at an end where the depth appeared perfectly shallow. To his surprise, however, he found himself the next moment in seven feet of water, and then, and not till then, the teaching of his Cambridge days came back to him, and he reproached himself that he had not known better. For the rest it mattered not, for in those olden days Cambridge had not known a stouter swimmer, and, happily, that one art so foreign to man, when once learnt, never deserts him more.

Radiation from Hydrogen Peroxide.

MUCH interest has been caused in Germany by the statement that it was found that photographic plates were affected by hydrogen peroxide, even though screened by thin sheets of metal. It has been suggested, on the other hand, that the hydrogen peroxide is capable of penetrating such screens through minute and inperceptible holes.

The International Catalogue of Scientific Literature.

"THE International Catalogue of Scientific Literature," published for the International Council, by the Royal Society, London—Harrison and Sons. 17 vols. 8vo. Price, £18.

IT is probably known to most of our readers that one of the greatest difficulties encountered in these days by workers in all branches of science is to ascertain what their fellow-workers have lately done and are now doing. This difficulty is greatly increased by the enormous number of scientific periodicals published all over the world. Besides the numerous journals devoted to special subjects, every museum and other scientific institution issues its own "Proceedings" or "Transactions," which often contain scientific information of the most varied character. Taking Zoology, for example, we find in the last volume of the "Zoological Record" a list of the titles upwards of a thousand periodicals devoted to that science alone, and in other branches of science there is probably a corresponding number of publications of this sort, which have to be carefully studied, in order to find out who is working, and what has been written on any particular subject. It is obvious, therefore, that even a catalogue of the titles of published books and papers would be a very great assistance to workers in science.

The idea of forming such a catalogue of scientific books and papers seems to have been first entertained in modern days by the late Dr. Joseph Henry, Secretary of the Smithsonian Institution at Washington. Dr. Henry sent a communication to the meeting of the British Association at Glasgow in 1855, suggesting the formation of a catalogue of Philosophical Memoirs, which was favourably reported upon by a committee appointed to consider it. Two years later, in 1857, the late General Sabine brought the subject before the Royal Society, and requested the co-operation of that Society with the British Association on this matter. After some negotiations the Royal Society ultimately took up the undertaking seriously and published the first volume of their catalogue of scientific papers in 1867. This was subsequently continued until there are now twelve large quarterly volumes which contain the titles, alphabetically arranged according to the authors' names, of all the scientific papers published from 1800 to 1885. On referring to the last report of the Council of the Royal Society we find it announced that the great work of completing this catalogue to the end of 1900 is now making rapid progress, but that the vast bulk of the material to be dealt with has much delayed its issue. When it is finished it will make the "Catalogue of Scientific Papers" complete up to the end of the last century.

The question of the best mode of ensuring the continuance of the catalogue during the present century, having been maturely considered by the Council of the Royal Society, it was determined that this arduous task could best be carried out by the mutual co-operation of all the nations interested in the progress of modern science, and an International Conference was consequently summoned by the Royal Society to consider the question. This Conference took place in London in July, 1896, and was attended by delegates from twenty-one countries. It was unanimously agreed by all the delegates that an "International Catalogue of Scientific

Literature" should be undertaken, and that it should commence on January 1, 1901, where the "Catalogue of Scientific Papers" would come to a conclusion. It was also agreed that the International Catalogue should be controlled by a "Central Bureau" established in London, while the other countries should each have a "Regional Bureau" to collect the necessary information on the spot and transmit it to the Central Bureau. At two other Conferences, held by the Royal Society in London in 1898 and 1900, the scheme was further elaborated, and numerous details were settled. It was agreed that the Catalogue should be published in London in seventeen annual volumes, each of which would relate to a separate branch of science and be distinguished by the letters from A to R. The general plan of the catalogue is given in the subjoined extract from the prospectus of it.

The "International Catalogue of Scientific Literature" contains an Authors' and a classified Subject-Index of the Scientific Literature published on and after January 1, 1901. Each country has undertaken to index its own literature. The material thus collected is sent to the Central Bureau in London, where it is arranged according to (*a*) Authors' Names and (*b*) Subject-matter, and published in annual volumes. A Schedule of Classification and an Index thereto are prefixed to each volume in English, French, German, and Italian. These, and Latin, are the only languages which are used in the Catalogue without a translation, but in the Authors' Catalogue the titles of all publications are given in the original language. Each volume contains the material received at the Central Bureau since the date of completion of the manuscript of the previous volume.

The following is a list of the seventeen volumes (A to R) of the First Annual Issue (1903-4) of the International Catalogue, and of the prices at which they are sold separately; the price of the whole set being £18:—

		Ordinary Volumes. Price.	Thin Paper Volumes. Price.
A	Mathematics	15/–	16/6
B	Mechanics	10/6	12/–
C	Physics (Part I.)	21/–	22/6
	(Part II.)	15/–	16/6
D	Chemistry (Part I.)	21/–	22/6
	(Part II.)	18/–	19/6
E	Astronomy	21/–	22/6
F	Meteorology	15/–	16/6
G	Mineralogy	15/–	16/6
H	Geology	15/–	16/6
J	Geography	15/–	16/6
K	Palæontology	10/6	12/–
L	General Biology	10/6	12/–
M	Botany (Part I.)	21/–	22/6
	(Part II.)	18/–	19/6
N	Zoology	37/6	39/–
O	Human Anatomy	10/6	12/–
P	Physical Anthropology	10/6	12/–
Q	Physiology (Part I.)	21/–	22/6
	(Part II.)	18/–	19/6
R	Bacteriology	21/–	22/6

The second and third Annual Issues are now in progress of publication.

All scientific men will, we think, approve of the general plan of the "International Catalogue of Scientific Literature," and be very grateful to the Royal Society for the institution of a piece of work which cannot fail to be of material assistance in scientific research. But we will now proceed to consider shortly the way in which the initial volumes of the new catalogue have been prepared, and whether they contain the information required by the students of the branches of science to which they respectively relate. To this inquiry, however, we fear it is not possible to give a quite satisfactory reply. While some of the volumes of the first Annual Issue, to which we will confine our remarks, receive unstinted praise, others, it is only right to say, have met with a great deal of severe criticism. In the latter category we may specially point out the volumes on Palæontology and Zoology, both of which are generally considered not to be "up to the mark," as the phrase is. It is, of course, unreasonable to suppose that in commencing the difficult task of inaugurating such a gigantic undertaking as the present mistakes will not be made. We may also be quite sure that Dr. J. Foster Morley, the director of the whole undertaking, and his assistants in the preparation of the long series of volumes have done all in their power to avoid errors. But in some cases they have certainly not altogether succeeded in doing this. It has been shown on competent authority that the list of publications for the year 1901, which is, of course, the most important part of every volume, is by no means complete in the two volumes specified and in several others, and that the subject-indexes are consequently also defective. In the subject-indexes cases of misplaced titles are also by no means rare. These points, we hope, will be more carefully attended to in future volumes. But we venture to recommend that the so-called "Referee" of each volume should be given larger powers for additions and alterations than, as we understand, have hitherto been accorded to him. The Referee should be well paid for his labour, and should be deemed to be absolutely responsible for the correctness of his volume. It is, of course, absurd to suppose that the general editor of the work could be perfectly acquainted with all the sciences to which the seventeen volumes relate, and the responsibility should be attributed to the so-called Referees.

Having said thus much, we will add a few words upon some of the general features of the International Catalogue. In the first place, we object strongly to the shabby paper-covers in which the volumes are issued. They are quite useless for protection, and necessitate the immediate binding of the volumes, in boards at least. To deliver bulky volumes of this kind in thin paper covers seems to us to be a very unbusiness-like proceeding, and likely to hinder their sale. On the other hand, the paper and print of the volumes are decidedly good, though the margin left on each side is, in our opinion, decidedly insufficient. As regards the prices at which the volumes are sold, they are in many cases decidedly exorbitant. Scientific men, we are sorry to say, are seldom possessed of large means. To charge an unfortunate zoologist *thirty-seven shillings and sixpence* as the cost of his volume is, in fact, a prohibition to buying it, and will seriously interfere with the sale of the work. A third point to which we must call attention is the great delay that has taken place in the publication of the volumes. Those relating to 1901 should certainly have all been issued before the close of 1902. Scientific men, like other persons in these days, are always expected to be well "up to date," and cannot be required to wait three or four years for the information they require. Here, again, it may be answered that a new and gigantic undertaking like the present must be allowed a little time to acquire its full organization, and that we should not be too hard on the delay. To this we reply that delay is dangerous in this sort of work. It is often very difficult, if not impossible, to make up arrears, and unless strong means are taken *at once* to bring the "International Catalogue of Scientific Literature" completely up to date, it will lose, we fear, a great part of its undoubted value to workers in science.

XUM

The Optical Convention.

THE programme of arrangements for the Convention is now beginning to assume a definite shape, and particulars as to what is at present proposed will no doubt be of interest.

The Convention will be formally opened with an address from the President, Dr. R. T. Glazebrook, M.A., F.R.S., Director of the National Physical Laboratory, on the evening of Tuesday, May the 30th, and the gathering will extend over the four following days, up to and including Saturday, June the 3rd. The mornings will be devoted to papers and discussions, and in view of the interesting series of papers already announced, there is no doubt that this most important section of the proceedings will result in valuable contributions to Optical science, and will fulfil the aims which those who have been active in promoting the Convention have set before them. In addition to the papers, demonstrations of apparatus of special interest will be given in the afternoons in the Laboratories of the Department of Technical Optics of the Northampton Institute.

The Exhibition of optical and scientific instruments will be held in the large Hall of the Northampton Institute, and will be open daily to the public from 12 to 10 p.m., between May 31st and June 3rd inclusive. The charge for admission will be one shilling during the day, and sixpence after 7 p.m.

The Catalogue is now in active preparation. The arrangement made by the "Exhibition and Catalogue" sub-Committee that each section should be dealt with by an expert in the construction of the instruments represented in the section, together with an independent scientific member of the Committee, will ensure that all classes of instruments shall be adequately dealt with and described. It is proposed to fix the sale price of the Catalogue, which will be a volume of some 300 quarto pages, at 1s. 6d.; while in large numbers of 100 and upwards, the Catalogues will be issued to firms at a cost of 1s. each. The Hon. Secretary would be glad to hear at once from firms wishing to take a number of the Catalogues for private distribution.

Arrangements for promoting the social interest of the gathering, and for providing for the comfort and convenience of members attending from outside London, are now being considered by a "Hospitality and Entertainments" sub-Committee. In addition to the Presidential address, to be given on the Tuesday evening, which has already been mentioned, there will be an evening lecture by Professor Silvanus P. Thompson, D.Sc., F.R.S., on "The Polarization of Light by Nicol Prisms and their Modern Varieties." On a third evening it is proposed to hold a Conversazione; and for the Saturday afternoon, a visit to the National Physical Laboratory at Teddington is proposed, at the kind invitation of Dr. Glazebrook, the President of the Convention.

Further particulars will be announced later, when the programme is more definitely settled. It will greatly help towards ensuring the social success of the Covention if intending members will send in their applications at once; the subscription for membership is 5s. The Hon. Secretary, Mr. F. J. Selby, Elm Lodge, Teddington, Middlesex, will be glad to hear from those wishing to join the Convention.

The "Local Societies and Representatives" sub-Committee is dealing with the question of facilities for the attendance of visitors from a distance. The Secretary of this Committee is Mr. W. Rosenhain, B.A., 443, Gillott Road, Edgbaston, Birmingham. Mr. Rosenhain will be glad to give information in answer to enquiries, and will also be ready to receive applications for membership of the Convention.

A Curious Induction Experiment.

By CHARLES E. BENHAM.

THE following curious experiment, simple as it is, will probably be new to most readers. Place on a level table two glass tumblers which have been first freed from any superficial moisture by warming them near a fire. Lay a book on each tumbler, the two books being of similar size. The longer sides of the books should be parallel with each other, and the supporting tumblers should be at such a distance apart that the two books are about one inch apart. Place a third book of the same size on a sheet of glass, which must also have been well warmed at the fire. The third book must be laid so that it rests crosswise over the other two, with the sheet of glass

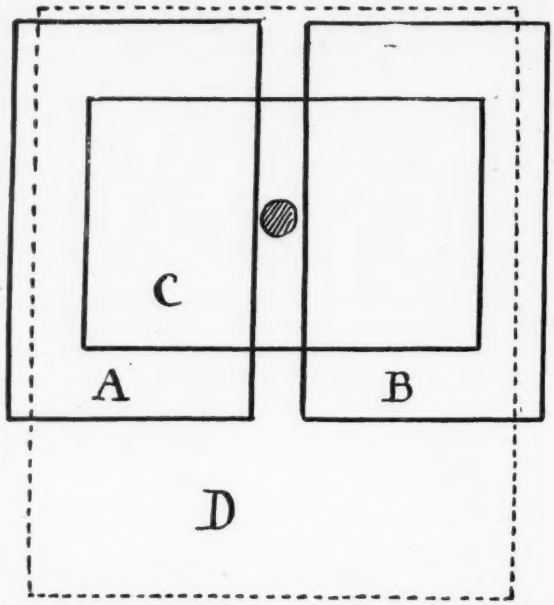


Fig. 1.—A and B the two lower books. C the upper book, resting on the glass plate D, and carrying a small coin, laid on the top of the book.

between them, as shown in fig. 1, in which the dotted line represents the piece of glass, the proportionate size of which is thus indicated. On the top book lay a penny, as indicated in the diagram, to act as a conductor for drawing off the electric sparks which are to be produced by this singular arrangement. Now taking the glass carrier, and holding it near the front edge, move it, with its book, horizontally right and left, so that the upper

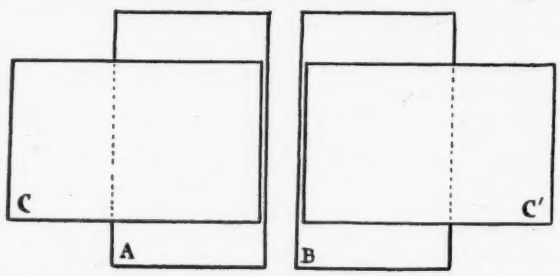


Fig. 2.—A and B the two lower books. C the upper book (the supporting glass plate not shown) in its extreme left position. C' the same book in its extreme right position.

book is in turn over each of the lower ones, in the alternate positions shown in fig. 2. Whenever it reaches either of these extreme positions, touch the book underneath it with the finger, taking care not to touch the other book, nor the upper one. When the upper book is in the intermediate position shown in fig. 1 it must be touched, taking care to avoid the earthing of either of the others. Repeat this cycle of movements twelve or twenty times, and then, on lifting the glass plate with its book away from the influence of the other two, a little spark may be drawn from the penny on presenting a finger to it. After drawing the spark replace the plate in the intermediate position (fig. 1), and on earthing the upper book again by touching it as before, its charge will be restored. Continuing the movements, it will be observed that the charge is a growing one, increasing at each cycle, being only limited by leakage from the book corners and by the capacity of the book surfaces. The charge on the upper book may be given up to a Leyden jar each time without loss if the communication from it to the jar is always made previous to its intermediate position, in which, when it is earthed, its loss is made good by induction from the books below. Using large books on the tumblers and, for the upper one, a book of equally extensive surface, though thin for the sake of lightness, quite a strong charge may soon be accumulated in the Leyden jar. If the tumblers and glass sheets are coated with shellac varnish they are less liable to be affected by moisture, and the preliminary warming is unnecessary unless the atmosphere is very damp. The effect is enhanced by using rounded pieces of board instead of the books, and the best effects of all are produced if the conductors are of metal. Three shallow cake tins, about eight inches in diameter, will give very fine sparks, and the snap of the induced charge quickly becomes audible at each successive earthing, the spark of inflowing electricity becoming larger each time until the limit of capacity is reached. The glass will indeed soon become so highly charged that in moving it the cake tin will adhere to it by attraction, while if the lower tins are close together a spark will also frequently fly between them as the upper tin passes from one side to the other. When this happens, however, the process of accumulation is to some extent checked, and the proper distance apart is the shortest distance at which such cross-sparking does not occur.

The experiment is really a modification of one which has already been described and explained in "KNOWLEDGE" (November, 1904). Each of the lower books receives an infinitesimal charge by induction from the upper one, which, without losing any of its own, is in its central position enabled, when temporarily earthed by touching, to take up an induced charge from the joint influence of both the under ones. Its original charge is thus multiplied at each cycle. Where that original charge comes from is, of course, a mystery. It is infinitesimal, but it is there somehow, and may be either positive or negative—sometimes one, sometimes the other. It appears that all insulated bodies are at a slightly different potential from earthed bodies, and though it may be difficult to say exactly why they should be, the fact that they are is sufficient to account for the apparent miracle of self-excitement which characterises nearly all induction machines.

Perhaps one of the most interesting suggestions arising from the experiment suggested above is in connection with the phenomena of atmospheric electricity. The effect of the movements of the books is so obviously suggestive of the influence which cloud masses must exert upon each other when one passes over two, with an intervening space to separate them, that there is no resisting the conclusion that in the phenomena of the thunderstorm we frequently witness on a large scale an almost precisely similar experiment of Nature to that which we have been performing on the dining-room table with the three books to represent the cloud masses. Especially suggestive is the flashing of the sparks from one of the lower plates to the other, which occurs, as already mentioned, when they are placed very close together every time the upper plate passes across them. Here undoubtedly we have the very counterpart of the phenomenon often observed in a thunderstorm, when, drawn by the influence of some upper layer of moving cloud, the lightning flash darts across from one charged cloud mass to another in a lower stratum.

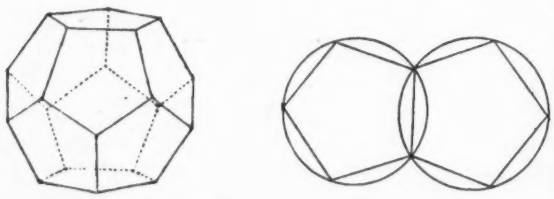
Star Maps.

WITH this number we present the first of a series of Star maps, which we hope will be found useful to our readers. These charts of the heavens embody some new ideas of design which, while causing the stars to be clearly depicted as they appear in Nature, yet enable the student at once to identify the individual stars and constellations.

One of the most difficult points to decide upon has been the method of projection. It is, of course, impossible to represent all the objects on a spherical surface, such as that which the heavens appear to be to our eyes, in their exact relative positions on a flat piece of paper. If, however, that piece of paper be cut up into a number of small independent planes, each can more accurately represent one portion of the sphere. So if the surface of a globe were cut up into a hundred equal parts, each of them would be practically flat, or if absolutely flattened the position of the stars marked thereon would not be greatly distorted. But such a series of very small maps would be of comparatively little practical use. The principal constellations would be split up into many parts, and their general appearance lost. It is desirable to form the maps in sheets as large as possible, both for convenience of reference and for noting the relative positions of stars and groups of stars. If we find one object on a map we may wish to see in which direction the various neighbouring stars lie, but this would be almost impossible on very small maps. So for practical work we require the maps to be as comprehensive as possible. But any division of the globe into parts has, to some extent, the objection that constellations and other groupings are often divided. This may be overcome by so arranging the maps that they overlap somewhat, and the stars appearing near the borders of one may be repeated on an adjacent map.

Taking all these points into consideration, we believe that no method can be better than that adopted by Proctor in his "Star Atlas" (published in 1870), and it seems appropriate that we should adopt the system first introduced by the founder of "KNOWLEDGE." We can but repeat the words of his Introduction. "It is clear that, *cæteris paribus*, that plan is best which represents the celestial sphere in the smallest number of maps. Further the maps should be convenient in size but yet on a sufficiently large scale; and

of two plans, otherwise equal, that one will be best which, on a given scale, and with a given number of maps, makes the maps cover the least possible area. It is also obvious that the distortion and scale variation of a map should be as small as possible." He also says "There is only one plan according to which such an atlas *can* be constructed so as to satisfy even the chief requisites which Star Charts are intended to meet." If the maps are to be of equal size and shape, the surface of the sphere must be approximated by a solid figure composed of a number of faces each forming a polygon. But of these the most suitable is the dodecahedron, or solid figure composed of twelve pentagons. From the figure it will be evident how each one of the pentagons,



though forming a flat plane, will not require that the position of the objects depicted upon them will be much distorted from those on the surface of a sphere. It will be noticed that the distortion is greatest in the angles of the pentagons, so if a circle be circumscribed around the pentagon, the distortion of those parts outside the pentagon will be no greater than those in the angles, and the circle will practically occupy no greater space of paper than the pentagon. By adopting the circle instead of the pentagon we also obtain another important feature, and that is the overlapping of the adjacent maps. In these 12 maps one-fifth of the heavens is included in the overlaps. Occasionally stars lying near, but outside, the border are shown, so as to complete the principal members of a constellation.

Having decided upon this system, the next question was as to the colouring and mode of representing the stars. Most maps mark the stars in black on a lighter ground, the opposite to Nature, and causing much confusion with letters and signs. White stars on a blue ground have therefore been adopted.

The names of the constellations are here put in large letters, so arranged as to cover as far as possible the constellation, and yet being so placed as not to interfere with the individual stars. The lines of R.A. are only given for the hours, though around the border divisions are put corresponding to each ten minutes, and Declination lines are put at each 5 degrees.

As regards the nomenclature of the stars, we have added *names* to all those mentioned in the Comte de Miremont's Popular Star Maps, the *Greek* letters to those recognised by such, and Flamsteed's numbers to others. There remain many other smaller stars, which bear various numbers according to different catalogues, but we have thought it best to leave them unnamed, as otherwise confusion may be caused.

The brilliancy of the stars, known by the misleading designation of "magnitudes," but which, of course, has nothing to do with the actual size of the stars, are here given according to conventional shapes (as shown on each sheet). The actual size represented varies slightly, since the stars are not, as a rule, of any *exact* magnitude. These are entered in accordance with the Harvard Photometry.

The Milky Way has been added in a manner which may not perhaps appear wholly satisfactory, but it becomes a practical difficulty to depict that which is but a mass of stars in such a way as to interfere as little as possible with stars superposed upon it. Many other practical difficulties have appeared during the construction and printing of the first map, but in future we propose to employ a slightly different system, which should secure greater clearness and accuracy.

MAP I.

North Polar Stars.

This is perhaps the most important map of the whole series for several reasons. All the stars here represented are *always* above the horizon in England. One of the chief practical uses in a knowledge of the position of the stars is to be able to ascertain the direction of true north. By becoming conversant with the lie of the chief stars in this region the north point is readily noted. Besides these this map happens to include several of the most conspicuous and easily remembered constellations in the heavens, viz., the Great Bear, the Little Bear, and Cassiopeia.

It may be almost superfluous to mention that the North Pole of the heavens is found by prolonging the line of the "pointers" (β and α *Ursæ Majoris*) towards Polaris, which star stands very much alone, and close to the Pole. If Polaris be joined by an imaginary line to the end of the "tail" of the Great Bear (η) the Pole will be approximately where these two lines cross.

Among the more noteworthy stars and other interesting objects to be found in this map are the following:—

δ *Cephei* (2.h. 25m. + 57° 54′). Double. The principal star is variable from 3·7 to 4·9 magnitude, and is a spectroscopic binary of great interest. The variability, in this case, is proved not to be dependent on eclipse obscuration with a darker body, but seems to be due to an actual variation in radiating power.

α *Cassiopeiæ* (oh. 34m. + 55° 59′) is a quadrupal and irregular variable ranging from 2·2 to 2·8 mag.

η *Cassiopeiæ* (oh. 43m. + 57° 17′). A binary, the two stars being of 3·5 and 7·5 magnitudes respectively, at a distance apart of 5″·68.

σ *Cassiopeiæ* (23h. 54m. + 55° 12′). A double star, one white, of the 5th magnitude, the other blue of 7·5 magnitude. Distance apart 3″·0.

Perseus, between 9 and 5 are two clusters. Near this point a Nova was discovered in 1895, of the 9th magnitude.

α *Ursæ Minoris*, "Polaris" (1h. 23m. + 88° 46′). Mag. 2·12. This is a double star, the smaller one at a distance of 19″ being of 9th magnitude. The larger star is a spectroscopic binary, period 4 days, probably having two dark companion stars.

In *Ursæ Major* close to β is situated the "Owl Nebula" (11h. 9m. + 55° 34′) invisible to the naked eye, but by aid of powerful telescopes is seen to consist of two spirals formed in opposite directions.

ζ *Ursæ Majoris*, "Mizar" (13h. 20m. + 55° 26′). A well-known double star, magnitude 2·1 and 4·2, distance apart 14″·4. Position angle 147°·4. The larger star is a spectroscopic binary of two bright and equal components. "Alcor," 5th magnitude, is 11″ away from ζ.

Draco. A gaseous nebula, of a pale blue colour, lies close to the north pole of the ecliptic. (17h. 59m. + 66° 38′).

From a point in *Perseus* (3h. om. + 57°) come the well-known Perseids, or meteor showers, about the 9th-11th of August.

BRIGHTNESS.

1st May.

2nd ,,

3rd ,,

4th ,,

5th ,,

6th ,,

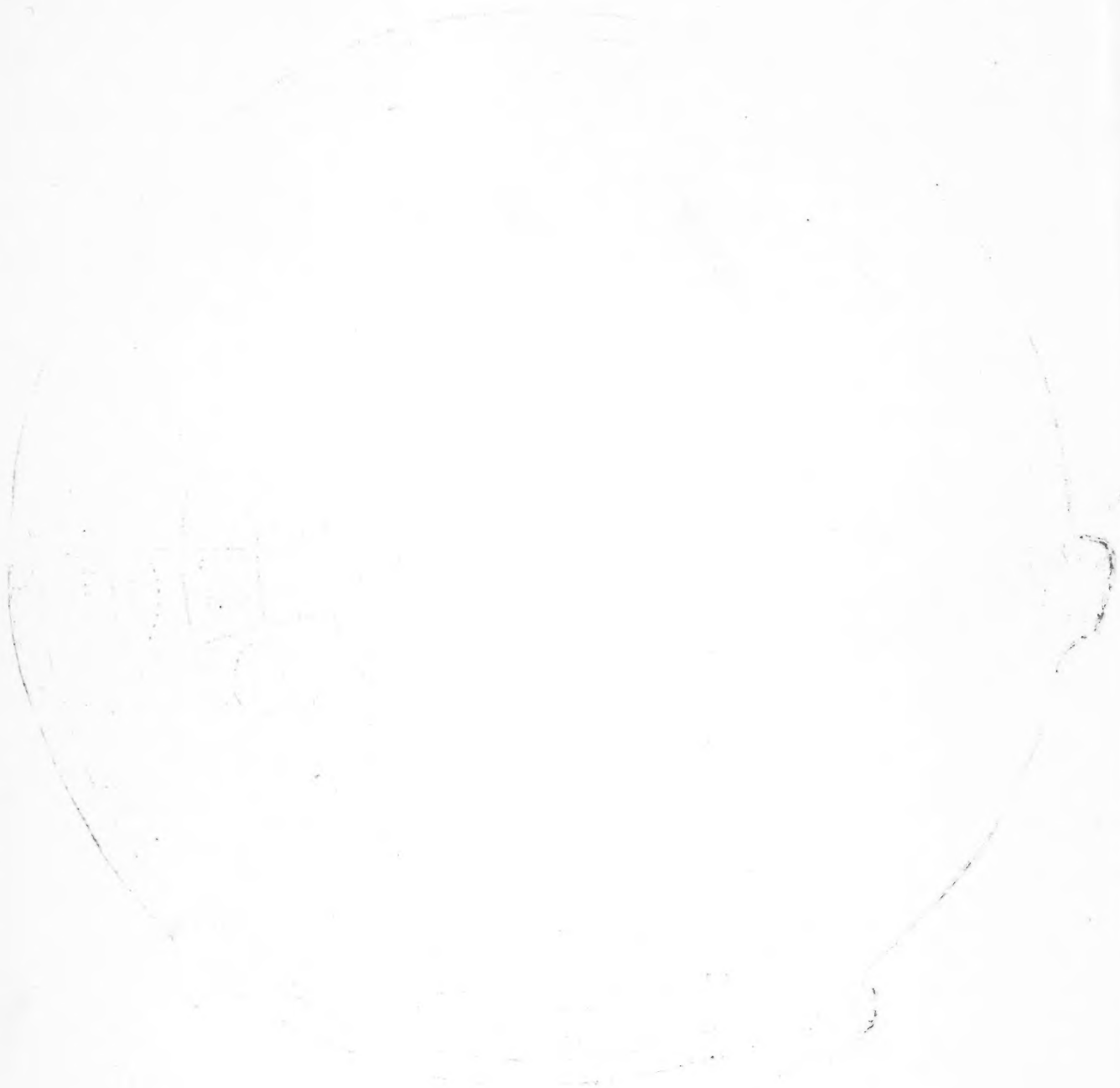
Variable.

Nebula.

MAP No. 1.

Northern Polar Stars.

XUM



XUM

Mammals that Carry Their Young.

By R. LYDEKKER.

"WHILE taking bats one day in December, I captured a female of our common Buenos Ayrean species (*Molossus bonariensis*), with her two young attached to her, so large that it seemed incredible she should be able to fly and take insects with such a weight to drag her down. The young were about a third less in size than the mother, so that she had to carry a weight greatly exceeding that of her own body. They were fastened to her breast and belly, one on each side, as when first born; and possibly the young bat does not change its position, or move, like the young developed opossum, to other parts of the body, until mature enough to begin an independent life. On forcibly separating them from their parent, I found that they were not yet able to fly, but when set free fluttered feebly to the ground. This bat certainly appeared more burdened with its young than any animal I had ever observed."

Thus wrote Mr. W. H. Hudson in that delightful book, "The Naturalist in La Plata," rather more than a dozen years ago. The passage appears, however, to have been generally overlooked by later naturalists (the present writer among the number), for in 1902 the fact that certain female North American bats habitually carry about with them more than a single offspring clinging to their own bodies was brought to notice as an entirely new discovery. So utterly incredible, indeed, did it appear to naturalists of an earlier date, that a bat should be able to fly with a couple of young ones clinging to her breast, that in 1878 the late Dr. G. E. Dobson expressed the opinion that, in the case of twins, one of the pair might be transferred to the male parent, and carried about by him. Not only, however, has no instance of such a transference ever been observed, but the discovery that female bats are capable of carrying not only two but actually four offspring about with them indicates that, in the great majority of species, it never occurs at all.

The case of the above-mentioned North American bat (*Lasiurus borealis*), of which a full description will be found in "KNOWLEDGE" of November, 1903, altogether eclipses the instance quoted by Mr. Hudson, for two specimens of this species have been brought to notice with four young ones clinging to their nipples. And although no one has hitherto taken a female thus loaded in actual flight, from the fact that bats of the genera *Lasiurus* and *Dasypterus* are furnished with two pairs of nipples, it appears probable that a quartette of young ones is commonly carried by the female parent during her aërial wanderings. On the other hand, as European bats have but a single pair of nipples, it may be inferred that the females never carry more than two young, although an instance of even this does not ever appear to have been observed.

As already mentioned, the weight of the twins actually seen to have been carried by the South American species is reported to have greatly exceeded that of her own body. In the case of one of the North American specimens, the weight of the quartette was 12.7 grammes; while that of the mother was only 11 grammes. The offspring in this instance were, however, much younger than in the case recorded by Mr. Hudson, so that it is a fair inference in the instance of the North American species that the weight of the offspring would have eventually doubled that of the parent before the burden was finally discarded. How such a sorely over-burdened mother could have managed to fly at all is little short of a miracle.

From their peculiar mode of life it is, of course, evident that bats of all kinds must habitually carry their young about with them; and in the case of the large fruit-bats, or flying-foxes, which can be easily kept in captivity, it has been observed that in repose the young cling head-downwards to the under surface of the body of the female parent (Fig. 1). In the remarkable naked bat (*Chiromeles torquata*), of the Malay countries, the absence of fur would, however, effectually prevent the young being carried about in the ordinary way; and we accordingly find the nipples enclosed in large pouches of skin, which doubtless form receptacles for the young bats. From the fact that these pouches are present in both sexes, it has been suggested that, in the case of twins, the care of one of the pair is undertaken by the male parent. Even, however, if twins are ever produced by this species, the case of the above-mentioned American bats suggests that no such transference of a share of the burden is essential.

Fig. 1.—Female Fox-Bat with young. (From Sclater, *Proc. Zool. Soc*

Next to these sorely-tried American bats, the most overburdened animals would appear to be the females of the American opossums, some of which are in the habit of carrying their numerous progeny about with them on their backs, as many of the young as can find room securing a firm hold by twisting the tips of their own prehensile tails around the tail of their parent, which, in some instances, at any rate, appears to be bent forward over her back for this special purpose. In the case of one of the larger South American species, which is considerably inferior in size to an average cat, Mr. Hudson tells us that he has seen as many as eleven young ones, each as large as a full-sized rat, carried about on the parental back. In this instance the burden must be proportionately greater than in the case of a terrestrial animal, for these opossums when thus loaded follow their usual practice of climbing swiftly and with the greatest agility among the higher branches of trees. Indeed, it would seem that the creature must capture its prey while thus burdened for the members of the family, like Sinbad's old man of the sea, seem never to voluntarily relinquish their equestrian position until old enough to shift for themselves.

XUM

To make the parental back serve the purpose of a perambulator seems, indeed, to be fashionable among South American animals, for Mr. Hudson tells us that the females of the large aquatic rodent of that country locally known as the coypu or nutria (*Myopotamus coypu*) are in the habit of carrying at least some portion of their family while swimming. Not that the little coypus, which usually number eight or nine, cannot swim perfectly well by themselves, but they are probably unable to keep up the pace for any distance, and it is quite common to see as many as can find room comfortably seated on their mother's back, and the rest swimming behind on the look-out for their turn for a ride. Whether beavers and water-voles ever carry their offspring about in this manner I have been unable to ascertain.

It is stated, however, on good authority, that the young hippopotamus is often carried on the back of its mother as she swims, although it is somewhat difficult to imagine how the little creature can maintain a secure foothold on such a slippery surface. Be this as it may, it is evident that the hippo, even though larger

Fig. 2.—Female Opossum and Young. (From Elliot's "Mammals of Middle America.")

than a good-sized boy, cannot be much of a burden to its colossal parent. A creature which habitually carries about its offspring on its back is the female koala (*Phascolarctus koala*), the native bear of the Australian colonists, which dwells among the highest branches of the lofty blue gum-trees, where it may be descried on moonlight nights by a practised observer when thus loaded (Fig. 3). The thick woolly coat of the parent affords excellent foothold to the young koala; and since there appears to be never more than one of the latter, the burden to the female cannot be excessive. The koala is a member of the marsupial order, in all the species of which the young are born in a helpless condition, and cling for some time to the nipples of the parent. After this they are usually carried for a period in the pouch in which the nipples are situated. The sojourn of the young koala in the pouch after leaving the nipple, if it takes place at all, must, however, be very short, as the creature takes a seat on the maternal back while still small.

The American opossums are likewise members of the marsupial order, but they present some very remarkable variations in regard to the development of the pouch. The common or typical species, for example, takes its name of *Didelphys marsupialis* from the presence in the female of a large and capacious pouch, in which the numerous members of the family are carried about until they attain a very considerable size and become a serious hindrance to the parent in getting about. On the other hand, in the above-mentioned South American species, commonly known as the thick-tailed opossum (*D. crassicaudata*), and likewise in the much smaller *D. dorsigera*, the pouch is rudimentary and functionless, and the young are carried about on the back of the female parent in the manner already described. Considering that all three species are thoroughly arboreal in their habits, the reason for the loss of the pouch in the two latter seems altogether inexplicable. If the female of one species can climb with her pouch full of young, there is no apparent reason why those of all the species should not be able to do the same; and so far as the young are concerned, they would seem, at all events in the younger stages of their existence, much better off in a nice warm pouch than in a somewhat precarious and decidedly exposed position on their parent's back, where, however, they have much better opportunities of seeing something of the world.

Fig. 3.—Female Koala carrying its Cub.

The females of all the species of kangaroos, wallabies, and rat-kangaroos always carry their offspring in the pouch until they are of very considerable size and quite able to look after themselves. In most cases there is only a single young one, but a second may be born before the first has quitted the pouch. In the case of the larger kangaroos, the young, or "Joey," which may be the size of a hare before it finally leaves the pouch, must be a very serious burden to the female when at speed. This is proved by the fact that although when first pursued the female parent will pick up and deposit in the pouch the "Joey" running by her side, yet that when very hard pressed she will not hesitate to eject her offspring and leave it to its fate in the hope of saving her own life.

The cuscuses of the Austro-Malayan islands and the phalangers—the mis-called opossums—of Australia itself, which are thoroughly arboreal creatures, all carry their young in pouches. Although there may occasionally be twins, as a rule there is but one at a birth, so that the mother is not burdened to any excessive extent by her load. Of the breeding habits of the flying-phalangers, or flying-opossums, of Australia, little or nothing seems to have been recorded; but since they have pouches, it may be assumed that the young, which are frequently four in number, are carried about by the female. As to the pigmy flying-phalangers—the flying-mice of the colonists—it is diffi-

cult to know what to say in this connection, as an anonymous writer tells of having seen a family of young ones cut out of a hollow tree without mentioning whether or no they were in the maternal pouch. On the other hand, the bandicoots (*Perameles*) and the native cats, or dasyures (*Dasyurus*), invariably carry their young about in the pouch, although in some of the species of the latter group the offspring make use of that shelter only for a very short period after they have detached themselves from the nipples. Not unfrequently there are six in a litter. Although the members of the Australian genus *Phascologale* are commonly called pouched mice, they scarcely deserve that title, since the pouch is generally reduced to a mere fold in the skin of the under-parts, and the young hold on to their mother mainly by the aid of her long hair, in which they are more or less completely concealed. From eight to ten young ones have been seen clinging to the nipples of their parents; but how long after being able to move about by themselves they cling to the maternal body, and what proportion the united weight of a litter bears to that of the parent, do not appear to have been recorded. Eight or ten little ones, of whatever size, must, however, be a considerable load for a creature no bigger than an ordinary mouse, so that these little marsupials are certainly entitled to be included in the list of heavily-burdened mothers. There are other Australian marsupials which carry their young in the pouch, but these need not be specially mentioned. On the other hand, in the curious banded anteater (*Myrmecobius fasciatus*) the pouch is obsolete, and the young, after becoming detached from the nipples, are probably brought up in some hollow tree. On this point, as well as many others connected with the breeding of marsupials, we are, however, sadly in need of definite information. And here it may be mentioned that few of the numerous collectors who are now sent to all parts of the world to obtain specimens of animals bring back any information with regard to their habits; their sole object being to kill as many innocent and beautiful creatures as possible, and thus add a few more names to the already overburdened list of species and subspecies. The infinitely more important life-histories of the creatures are left alone. This is a great pity, for, without in any way decrying the importance of systematic and anatomical investigations, the life-histories of animals undoubtedly deserve our best attention.

Another Australian mammal, the spiny anteater (*Echidna aculeata*), must receive special mention here, since it is one of the egg-laying group, and during the breeding season the female carries her two eggs about with her in a temporary pouch till they are hatched. In what stage of development the young are hatched does not, however, seem to be ascertained, neither does there appear to be any information with regard to the length of their sojourn in the pouch after hatching.

We have already seen that bats of all kinds habitually carry their young about them until sufficiently old to fly by themselves; and it is obvious that all flying mammals must either follow this practice, or keep their young in nests to which periodical visits are paid. The flying-squirrels (not the marsupials wrongly so-called), which, by the way, do not really fly, but merely take long flying leaps by the aid of the parachute-like expansion of the skin of the flanks, adopt the former plan. On the other hand, the curious flying-lemurs, or cobegos (*Galeopithecus*), of the Malay countries and the Philippines, which also merely take flying leaps, carry their young about with them in the same manner as bats. Dr. A. R. Wallace, for instance, describes shooting a female cobego, to whose breast adhered a small, blind, and naked young one, which reminded the observer of the helpless offspring of marsupials, although it was in a somewhat more developed condition. How long the young cobego makes use of its parent as a kind of flying-machine, and to what extent the mother is hampered by the weight of her offspring, are, however, interesting points in regard to which we have again to deplore a total lack of information.

The only other mammals that habitually carry their young are the members of the order Primates, which includes the human species, apes, monkeys, and lemurs. Among these, except when the task is delegated to the husband, the nursemaid, or the perambulator, the practice is universal on the part of the female; the male apparently never taking upon himself the duties of nurse among mammals other than man. In the case of monkeys and apes the young appear to be generally carried clinging to the breast of their mother or on her back. Some of the lemurs

Fig. 4.—Female Lemur and her Baby. (From Sclater, *Proc. Zool. Soc.*)

at any rate have, however, an altogether peculiar method of carrying their living burden, the young lying transversely across the abdomen of the female parent, with its head on one flank and its tail on the other (Fig. 4). In this strange position the baby lemur is probably carried with less inconvenience than would be the case in any other way; and since the young of these animals appear to be thus carried till they are of comparatively large size, such a consideration is of considerable importance.

In conclusion, it may be mentioned that two points are brought into prominent notice in this article. Firstly, the wonderful amount of care the mothers of many species of mammals devote to the well-being of their offspring, and the amount of physical labour and endurance they are willing to undergo for this object. Secondly, the extremely imperfect state of our knowledge with regard to the breeding habits of many of the species noticed in the foregoing paragraphs, and the urgent need that exists for careful observation on these and other habits if zoology is to be raised to something more than a mere catalogue of species and description of anatomical details.

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NOTES.

ASTRONOMICAL.

New Comet 1905(a) Giacobini.

A TELEGRAM received on the 27th March from the Kiel Centralstelle announced the discovery of a new comet at Nice, on the 26th March, by M. Giacobini, for which the following co-ordinates have been furnished:—

RA. = 86° 3′ 30″ (5 h. 44 m. 14 s.) } 1905. March 26·12. 8 h. 11·8 m.
Decl. = + 10° 56′ 56″ } Nice Mean Time.

A later telegram confirmed the discovery by the comet being seen at Lick on March 27 in the position:—

RA. = 5 h. 48 m. 55 s. } 1905. March 27. 7 h. 57 1 m.
Decl. = + 12° 35′ 43″ } (Lick Mean Time.)

The observations indicate that the comet, on discovery, was situated in the North-East of the constellation of Orion, between the stars α and γ, and that it is moving in a north-easterly direction at the following rate:—

Daily motion in RA. = + 45′
" " " Decl. = + 1° 15′

From the observations obtained on March 26, 28, and 30, the following Ephemeris elements have been computed by Herr E. Strömgren.

T = 1905, April 3·2098 (Berlin Mean Time).
α = 357° 9′·49
Ω = 156° 7′·94 } (1905·0)
i = 41° 37′·48
log q = 0 05232.

* * *

Photography of the Solar Corona in Daylight.

For many years astronomers in all parts of the world have been experimenting with various devices in the endeavour to obtain records of the solar corona at ordinary times, but without success. M. A. Hansky has during the last four years been pursuing this inquiry in the exceptionally favourable atmosphere at the summit of Mont Blanc. He found by preliminary trials that the spectrum of the diffused sky light was very feeble in the red region compared with the intensity of the green and yellow portions. It is a fortunate condition that in the solar spectrum the red rays are relatively less absorbed in their passage through our atmosphere than the more refrangible rays; and as the continuous spectrum of the corona is very intense in the red region, it appeared feasible to attempt photography of the coronal structures by means of these red radiations, obtaining the necessary contrast by passing the light through a screen suitably prepared to cut off all except the red rays. After numerous tests of many aniline dyes in solution, a combination was found which completely absorbed all the spectrum radiations from λ 6600 to the extreme ultra violet, the colours used being red, orange, malachite green, and gentian violet. The absorbing screens were made by steeping fine grained Lumière films, previously fixed without development, in concentrated solutions of the corresponding colours. These were then placed between two glass plates, one with plane parallel faces, the other coated with the usual sensitive emulsion.

An opaque screen slightly larger than the diameter of the solar image was placed on the outer glass plate, so that the light from the brilliant photosphere was prevented from reaching the sensitive plate.

By the permission of M. Janssen, the photographs were made with the 12-inch telescope of the Mont Blanc observatory. On September 3, 1904, twelve photographs were obtained of the circumsolar regions, with exposures varying from 30 seconds to 2 minutes. The positions of the screens were changed so as to eliminate any local effects due to them on the plates. The negatives obtained were copied and secondary negatives obtained by intensification, giving increased contrast, which are stated to show remarkable resemblance to those of the solar corona photographed during total eclipses.

M. Janssen adds a few words in support of the forms thus photographed being truly coronal, and M. Hansky suggests that by a suitable alteration in the colour of the screen used, it may be possible to photograph the images of the prominences in the red light of wave length of the C line of hydrogen.

In a short criticism of this work of Hansky, M. H. Deslandres suggests that it would be a great improvement if special precautions were taken to eliminate the diffused light in the photographic instrument itself. In the apparatus as used, light would be reflected back from the disc cutting out the sun's direct image to the surfaces of the objective, and from these some light must necessarily be again irregularly reflected towards the photographic plate, where it will tend to produce a diffused glow round the edge of the occulting disc. The direct solar radiation is estimated to be about 200,000 times as intense as that of the corona, and if we assume the irregularly reflected and diffused sunlight from the occulting disc and object-glass surfaces to be 1-100th part, it is evident that this would still be far stronger than the corona it is desired to photograph. It is suggested that the occulting screen be placed outside the instrument altogether, at such a distance that it will obscure the sun's disc and also a slight amount of the more intense base of the corona.

* * *

Search Ephemeris for Tempel's Periodic Comet, 1867 II.

It being probable that the periodic comet discovered by Tempel in 1867, and afterwards observed in 1873 and 1879, may return during the present year, M. R. Gautier has prepared a provisional search ephemeris to aid in its identification. There appears to be evidence that the perihelion distance of the comet has been considerably increased by the perturbations induced by Jupiter, the element being almost double its former value in 1867. This factor will probably cause a great diminution in the intrinsic brightness of the comet. It is hoped, however, that the favourable conditions of the coming apparition may permit of its observation; perihelion passage occurs in the spring, a little before opposition. There is a slight uncertainty of ± 12 days in the epoch of perihelion passage, and the ephemeris is therefore given for each of the extreme times in addition to the more probable mean values. The following are the elements on which the ephemeris co-ordinates are based:—

T = 1905 April 20·5 Berlin mean time.
μ = 542″·68.
φ = 23° 42′·0.
i = 10° 47′·2. } (mean equinox 1905.)
Ω = 72° 41′·7. }
ω = 168° 40′·3.

For preliminary purposes until the comet be sighted it will be sufficient to give the positions for every fourth day.

Ephemeris for Berlin mean Midnight.

	T = May 2·5		T = April 20·5		T = April 8·5	
1905.	R.A.	Decl.	R.A.	Decl.	R.A.	Decl.
	H. M. S.	° ′	H. M. S.	° ′	H. M. S.	° ′
May—						
2·5	17 9 55	−19 14·6	17 40 58	−21 16·5	18 10 31	−22 48·1
6·5	9 13	39·7	41 13	43·4	11 44	23 15·1
10·5	8 1	20 5·8	40 56	22 11·4	12 25	43·5
14·5	6 20	32·9	40 8	40·4	12 33	24 13·3
18 5	4 14	21 0·7	38 50	23 10·3	12 9	44·1
22·5	1 45	28·9	37 4	40 9	11 13	25 16·0
26·5	16 58 58	57·4	34 52	24 11·9	9 48	48·5
30·5	55 57	22 26·0	32 18	43·0	7 53	26 21·5
June—						
3·5	52 48	54·3	29 26	25 13·9	5 34	54·5
7·5	49 37	23 22·2	26 22	44·2	2 54	27 27·1
11·5	46 29	49·4	23 11	26 13·5	17 59 58	58·9
15·5	16 43 30	−24 15·9	17 19 59	−26 41·6	17 56 50	−28 29·5

CHEMICAL.

By C. A. MITCHELL, B.A. (Oxon.), F.I.C.

Application of the Serum Test to Mummies.

DR. UHLENHUT, of the Hygienic Institute of Greifswald, has attempted to determine the origin of mummy material by means of the specific serum test of which a description was given in "KNOWLEDGE & SCIENTIFIC NEWS" (this vol., p. 86). For this purpose aqueous extracts were made of a large number of mummies ranging from 1000 to 3000 years in age. It was found that these were strongly acid and gave a turbidity with *normal* rabbits' serum, but that when the acidity was neutralised they gave no reaction either with normal serum or with the *præcipitines* that had been rendered specific for human or other serum. This was eventually shown to be due to the fact that these extracts did not contain any albuminous substances, which if still present in the mummies were no longer soluble in water. On the other hand, mummies of comparatively recent date (up to 66 years) yielded extracts that at once showed their origin by giving pronounced precipitates with specific sera.

* * *

Ancient British Gunpowder.

In the course of excavations made at the beginning of this year in the public square of St. Martin-de-Ré (Charente Inférieur) the workmen unearthed trenches in which lay skeletons, presumably of those who fell when the town was besieged by the English in 1627. Among the *débris* was found a spherical iron bomb containing a moist black powder, which had been fired by the besiegers and had failed to explode. The powder, of which a specimen has been examined by M. L. Desvergnes, ignited readily after being dried, and was found to consist of about a third of nitre, a third of carbon, and a fifth of sulphur, the remainder being iron oxide derived from the rusting of the iron shell. After making allowance for this iron oxide and for the fact that a large proportion of the nitre must have been dissolved out by the water, these analytical results are in agreement with the composition of old English military gunpowder, which contained approximately 75 parts of nitre, 15 parts of carbon, and 10 parts of sulphur.

* * *

The Phosphorescence of Phosphorus.

Recent experiments made by Herr Jungfleisch show that the phosphorescence of phosphorus is due to the formation of an oxide. Thus if an inert gas such as nitrogen be passed over phosphorus contained in a vessel the vapour issuing into the air is only faintly luminous, but the admission of a minute trace of oxygen with the gas causes the phosphorus to phosphoresce and enormously increases the luminosity of the vapour. The oxide can be condensed by cold, for phosphorus vapour is rendered non-luminous by being passed through a vessel cooled to 50° F., while an inert gas subsequently passed through this vessel at a temperature of 60° F. becomes phosphorescent.

* * *

Luminescent Zinc Blende.

Zinc blende which possesses the curious property of luminescence has been discovered in California, Nevada, and other States of North America. The ore has a flaky structure, and varies in colour from light to dark grey. It consists, in the main, of a mixture of white barite (barium sulphate) and brown sphalerite (zinc blende), and also contains a considerable amount of gold and about 4 ozs. of silver per ton. It is not radio-active, but when scratched with a knife in the dark emits a series of sparks forming a line of light which follows the point of the blade.

* * *

Oxydases and their Work.

Everyone is familiar with the discoloration that takes place in a cut apple or potato on exposure to the air, and there are many analogous phenomena in the vegetable world. Thus several species of fungi, such as *Boletus luridus*, turn blue when broken, whilst beetroot rapidly darkens under the same conditions. In each case such changes are to be attributed to the oxidation of certain constituents within the plant, a combination with the oxygen of the air being brought about through the agency of certain organised ferments or enzymes termed *oxydases*. An enzyme may be defined as the material substratum of a peculiar form of energy produced by living cells, from which it is more or less separable. Oxydases, like other enzymes, such as the *pepsin* of the gastric juice, and the *diastases* of the saliva and of malt which convert starch into sugar, have not yet been isolated in a pure condition. Impure solid preparations have been obtained by treating the juice of the plant with alcohol and subjecting the precipitate to further purification. MM. Chodat and Bach have recently prepared very active and relatively pure oxydases from different fungi, &c., and find that they are not albuminous substances. The activity of oxydases is destroyed by heat, and thus a baked apple or boiled potato can be exposed to the air without darkening in colour. A general test employed to detect oxydases is based upon their behaviour with gum guaiacum tincture. Some, the *direct oxydases*, cause it to turn blue by combination with atmospheric oxygen, while others, termed *indirect oxydases*, only give the blue coloration when hydrogen peroxide is also present. This reaction is employed by M. E. Payet as a means of distinguishing between gum arabic and gum tragacanth. The former contains an oxydase and gives the blue coloration, while the latter produces no effect upon the guaiacum tincture. Oxydases are also produced by animal cells. Thus they have been detected in milk, in blood, in saliva, in the gills of the oyster and other molluscs and in the internal organs of many animals; and Dr. Dubois attributes the phosphorescence of the glow worm or other animals to the action of an oxydase, to which he gives the poetic name of *luciferase*.

GEOLOGICAL.

By EDWARD A. MARTIN. F.G.S.

Oscillations of Shore-Lines.

GLACIALISTS will feel considerable interest in Dr. Nansen's paper on this subject, which he read before the members of the Research Department of the Royal Geographical Society. Most of his illustrations appear to have been drawn from recent vertical movements of the Norwegian coast. This is, of course, closely bound up with the history of the Glacial Period, and apparently he has no difficulty in subscribing to the views of most modern geologists as to the great downward movement which occurred, at the greatest period of glaciation, in northern and north-western Europe, and if this view once be universally accepted we need go no farther for an explanation of the arctic-shell-bearing beds, which have been found at 1400 feet above the sea, and at lesser heights, at Moel Tryfaen, Gloppa, Macclesfield, and other places. It would be interesting to know how he views the suggestion, admittedly to some extent borne out by observations made during the last few years in Spitzbergen, that these shell beds were pushed or floated upward by ice, the molluscs not having themselves actually lived *in situ*.

Dr. Nansen stated that 42 per cent. of the continental surface of the earth stands between 600 feet above and 600 feet below sea-level, and adduces this fact to maintain that during a long geological period shore-lines have been at very much the same level as now. But though the coast line of Norway had been depressed in places 700 feet below its present level, in Dr. Nansen's opinion, because the land had been pressed down by the weight of the great ice-cap, yet in other places the depression had been very much less, viz., 30 feet to 60 feet. It was remarkable, however, that the land appeared to have a tendency to a certain mean position of equilibrium; and that, in spite of this great difference in the amount of depression, the coast had afterwards come to be at almost exactly the same level as that at which it stood previous to depression. On the subject of an actual rising of the surface of the ocean during recent geological times a decision must be postponed for the production of future evidence. An accumulation of ice around the North Pole might so shift the centre of gravity of the earth as to cause a rise of the ocean around our coasts. If, now that the Glacial Period is long past and gone, there

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remains a rise in the level of the ocean, then presumably the tail-end of that period still remains, and there is now more ice in Arctic regions than there was in those times immediately preceding the period. This is to some extent borne out, of course, by the fossil plant-remains of tertiary age, which have been found within the Arctic circle.

* * *

Drift Deposits.

In a paper on the Superficial Deposits of Central and Southern England, Dr. A. E. Salter, F.G.S., has summarised the various drift deposits over the area mentioned. The reprint of the paper, which was read before the Geologists' Association, will prove of great use to students of these surface accumulations. I should like to see more attention paid to the Merstham Gap in the North Downs, for, although the stream which cut it before the Weald was denuded has long been captured by the Mole, there is no doubt that the two intermittent bournes, from the gap, and along the Caterham Valley, represent all that is left of the river system of which the Merstham Gap is the chief visible work. Prestwich's thin covering of gravel at "West Ho, near Norwood," referred to by Dr. Salter, is much thicker than he knew. I have described elsewhere the gravel which extends from Westow Hill, Upper Norwood, south to Grange Hill, and some reputed palæoliths, and, according to some geologists, eoliths, have been found in sub-angular gravel at the top of South Norwood Hill, at 379 feet O. D. The high-level gravels of Upper Norwood are an important geological feature of days contemporary, I believe, with the existence of the arch of the great Wealden anticline.

* * *

Geological Maps and Samples.

Geologists may perhaps be interested in knowing that geological maps can now be ordered at most of the large post offices in London, as well as at head offices in the Provinces. Indexes and small specimen maps are kept at upwards of 700 head post offices throughout the country. The foreign sample post is an excellent medium for the transmission of geological specimens to and from abroad, natural history specimens, generally, being allowed by the authorities at the cheap rate of 4 ounces for one penny, when prepaid within the United Kingdom. They must not, however, be sent as articles of commerce.

* * *

Coal-Measure Classification.

On April 13th, a paper was read before the Geological Society of London by Mr. Robert Kideston, F.G.S., on "The Divisions and Correlation of the Upper Portion of the Coal-Measures." A new classification was proposed, by which the Upper Coal Measures were to be known as the Radstockian Series, a Transition Series as the Staffordian Series, the Middle Coal-Measures as the Westphalian Series, and the Lower Coal-Measures and Millstone grit as the Lanarkian Series. The proposed substitution of new terms for those which have obtained hitherto did not meet with much approval, and we sympathise with the protest which was made against the introduction of new terms, except under conditions of the strongest necessity.

* * *

The Phosphatic Chalk at Taplow.

A further paper read at the same meeting dealt with the "Age and Relations of the Phosphatic Chalk of Taplow," by H. J. O. White, F.G.S., and Llewellyn Treacher, F.G.S. The rocks were described in detail, and the following classification was adopted :—

		Feet.
E.	Upper White Chalk .. .. (visible)	16
D.	Upper Brown Chalk, or rich phosphatic band .. .. about	8
C.	Middle White Chalk .. .. ,,	16
B.	Lower Brown Chalk, or rich phosphatic band .. .. about	4
A.	Lower White Chalk .. .. (visible)	17

The Lower White Chalk includes a thin layer of tabular flint and one of elongated nodular flints, and the first signs of phosphatic material were observed a few inches below the tabular seam. Attention was drawn to the presence of phosphatic nodules and concretions at certain horizons; and the authors concluded that the Lower White Chalk belongs to the zone of *Micraster cor-anguinum*, and the succeeding beds to that of *Marsupites testudinarius*; while the lower phosphate-band represents the lower part of the *Uintacrinus*-band, and the upper one that of the *Marsupites*-band of that zone. In each phosphate-band the base is quite sharp, being defined by a rock-bed in the Chalk; but the upper limit is very ill-marked. The Middle White Chalk is in part divided into lenticles with slickensided surfaces. The authors found *Actinocamax verus* in B, and *A. granulatus* in D and E, but not *A. quadratus* in any bed. Phosphatization is not confined to the foraminifera, and other microscopic remains, but occurs in all shells and structures which are readily penetrable, although not so markedly in those of a more homogeneous character. *Scalaria* occurs in division E, the upper part of which may possibly just include the base of the zone of *Actinocamax quadratus*, or at any rate may not be many feet below that base. The distribution, numerical proportion, and, to some extent also, the morphological character of the microscopic fossils of the Phosphatic Chalk are exceptional. The authors of the papers think that a part, at least, of the phosphatized material has acquired its distinctive mineralogical character on the spot. So far as can be ascertained from existing data, the Phosphatic Chalk is confined to a small tract of country measuring less than 3½ miles from north-east to south-west by less than 1 mile from north-west to south-east.

ORNITHOLOGICAL.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

The Doom of the Penguin.

THE Penguins of Macquarie Island and the desolate Aucklands are in danger of extermination at the hands of the company promoter, and this fate will certainly overtake them unless steps are taken to save them.

Dr. E. A. Wilson points out that for some years past a considerable trade has gone on in the preparation of penguin oil, which is obtained by casting these unfortunate birds by the thousand into the melting-pot and boiling them down. No less than 100 tons of oil so procured has recently been placed on the market. Encouraged by success, a scheme is now afoot whereby cauldrons are to be set up on the Auckland Islands to facilitate this nefarious traffic. Hitherto the "rookeries" of these Islands have suffered comparatively little; but once the cauldron fires are lighted they will not be allowed to die out till the last survivor of the host has been flung into the seething broth. Surely no effort should be spared to frustrate this diabolical scheme.

* * *

A Great Egg Collection.

Our oological readers will be glad to know that Mr. Radcliffe Saunders has just presented his collection of 10,000 eggs to the Natural History Museum at South Kensington. This is the second donation of 10,000 eggs that Mr. Saunders has sent to the Museum. His last gift includes many rarities. The Raptorial series is complete, and so also is that of the crows, crossbills, and buntings. The collection of cuckoos' eggs (*Cuculus canorus*) is especially fine, numbering over 300 specimens. Their value is greatly enhanced by the fact that they have in every case been preserved with those of the hosts destined to hatch them.

The generosity displayed by Mr. Saunders cannot be easily over-estimated. He has placed at the disposal of oologists the world over a collection brought together with the most exacting surveillance. Till now, only a favoured few could derive any profit from these labours—henceforth all may benefit who will.

* * *

Hairy Waterhen at Bury St. Edmunds.

The *Zoologist*, for March, records the capture of one of those curious variations of the waterhen which occurs from time to time, wherein the feathers acquire a peculiarly loose structure, comparable to that which obtains in Ratite birds. In colour, this bird, as in other cases of this kind, is described as of a warm sandy-brown above, and greyish-white

beneath. The head and throat were normal both as to colour and the structure of the feathers. The bird was killed in January last, and is described as immature.

This makes the thirteenth recorded instance of this variation in the water-hen. So far, no really satisfactory explanation has been given of this curious "sport." Microscopic examination of the feathers shows that they are always much abraded, the tips of the shafts being broken off. The loose character of the feathers is due to the absence of barbules.

Partially "hairy" varieties of this type have been recorded in hawks and gulls, and in the case of a jacana and a grey Brahma hen.

Should any of our readers come across a similar variation of this kind in a freshly-killed specimen, we would suggest that a careful note should be taken of the colour of the eyes, skin, and bones.

* * *

Arrival of Summer Birds.

From the *Field*, April 15, we gather the following:—

Ring Ousel	Windermere, April 5.
Blackcap	Wellington College, Berks, April 9.
„	Mitcham, Surrey, April 13.
Wryneck	Rayleigh, Essex, April 1.
Whitethroat	Tooting Common, April 11.
Redstart	„ „ April 12.
Swallow	Exeter, March 23.
„	Upwey, Dorset, April 1.
„	Kettering, April 1.
„	Eastbourne, April 1.
Martin	Kettering, April 1.
Willow-wren	Tooting Common, April 1.
„	Walsall, April 1.
Cuckoo	Horsham, April 1.
„	Beaminster, Dorset, April 1.
Yellow wagtail	Axminster, March 11.
Tree-pipit	Wellington, April 4.
Stone Curlew	Warminster, March 27.
Common Sandpiper	Near Builth, April 4.

ZOOLOGICAL.

By R. LYDEKKER.

The Subterranean Texas Salamander.

ELEVEN YEARS ago several specimens of a very curious blind salamander were thrown up from a great depth by an artesian well in Texas, and were subsequently described as representing a new genus and species under the name of *Typhlomolge rathbuni*. Hitherto they have been generally regarded as related to the blind proteus, or olm, of the subterranean waters of Carniolo, whose habits were so well described years ago by Sir Humphry Davy. A lady worker, Miss Emerson, writing in the *Proceedings* of the Boston (U.S.A.) Natural History Society, has, however, come to the conclusion that this is a mistake, and that the creature (which she regards as a persistent larval form like the axolotl) is really a cousin of the common American salamanders of the genus *spelerpes*. So much for external resemblances.

* * *

Miscellaneous Items.

According to a French naturalist, Mr. H. G. de Kerville, an Indian palm-civet (*Paradoxurus hermaphroditus*) recently lived for a year and a half in a forest in Normandy. The creature had in all probability escaped from a passing ship, but it is certainly remarkable that such an essentially tropical animal should have made itself so thoroughly at home in this part of Europe. The new Orkney vole continues to attract much interest on the part of naturalists, Messrs. Clarke and Bradley discussing its affinities in the January number of the *Annals of Scottish Natural History*; while Dr. Forsyth-Major gives his views in the March issue of the *Annals and Magazine of Natural History*. The two views do not, however, altogether agree, the first paper suggesting that the creature is in some respects intermediate between the water-vole and the field-vole; while in the second it is urged that its relationships are solely with the latter and its Continental representative. In the *Zoologist* for April the present writer describes two new species of Oriental gorals, or goat-like antelopes, the one from the Western Himalaya, and the other from Burma.

* * *

Skeleton of the Okapi.

A recent issue of the *Bulletin* of the Malacological Society of Belgium contains a figure and description of the skeleton of a male okapi which has just been mounted for the museum at Antwerp. The structure of this skeleton is said to indicate an animal adapted to live in thick forest, and whose body can pass between tree trunks separated only by a very narrow space. All this is perfectly in harmony with the description which appeared not long ago in a German periodical of the natural haunts of the okapi.

* * *

Papers Read.

At the meeting of the Zoological Society on March 21st, Mr. R. I. Pocock read a paper on the effects of certain abnormal conditions on the horns of the American prongbuck, or prong-horned antelope, in captivity. On the same occasion Sir H. H. Johnston discussed the mammals and birds of Liberia, pointing out that although this district was closely connected with Sierra Leone on the one hand and with the Ivory Coast on the other, yet that it seemed to possess certain peculiarities of its own with regard to fauna and flora. Mr. M. A. C. Hinton, at the same meeting, described certain subfossil red deer antlers; while Dr. R. Brown contributed notes on the affinities of the extinct South African reptile *Procolophon*. At the meeting of the same Society on April 18th, the following three papers were down for reading, viz., Mr. A. E. Shipley on entoparasites from the Zoological Gardens and elsewhere, Dr. E. Lönnberg on hybrids between the common and the mountain hare from Southern Sweden, and Mr. R. H. Burne on the anatomy of the leathery turtle, or luth.

REVIEWS OF BOOKS.

Neolithic Dew-Ponds and Cattle-Ways, by A. J. Hubbard, M.D., and George Hubbard, F.S.A., F.R.I.B.A. Pp. 71. 25 illustrations. (Longmans, Green, and Co.) Price 3s. 6d. net. In this thin small-quarto the authors deal with the evidence which we have of prehistoric man in England in certain well-known dew-ponds, and in the cattle-ways, sometimes made by human hands and sometimes probably by wild cattle themselves, which lead to certain recognised watering-places. The book deals more particularly with considerations concerning Cissbury, Chanctonbury, and Maumbury Rings, Maiden Castle, near Dorchester, Ogbury Camp, and Figsbury Ring. We are not sure the authors are altogether justified in applying the term "neolithic" to all of them, and we think the balance of probabilities goes to show that Stonehenge is just as likely to be of neolithic workmanship as any of the great earth-embankments and trenches to which the authors refer. We cannot agree in assigning so recent a date to Stonehenge as 1800 B.C. The authors have been at great patience in tracing out what remains of the great Rings with which they deal, although they make no claim to have treated the subject exhaustively. Other well-known Rings will perhaps be dealt with at some future date. The book is fully illustrated, and many of the photographic reproductions are full-plate, and admirably illustrate the text.

The subject of the formation of dew-ponds is interesting, and the authors are apparently correct in assigning a great age to them. We are told that in this country there is at least one wandering gang of men, who will construct for the modern farmer a dew-pond, which will contain more water in the heat of summer than during the winter rains. The space hollowed out for the purpose is first thickly covered with a coating of dry straw. The straw is in turn covered by well-chosen, finely-puddled clay, and the upper surface of the clay is then closely strewn with stones. The margin of the straw has to be effectually protected by clay, since if it become wet it will cease to attract the dew, as it ceases to act as a non-conductor of heat and becomes of the same temperature as the surrounding

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earth. The puddled clay is chilled by the process of evaporation, and the dry straw prevents the heat of the earth after a hot day from warming the clay.

We remember hearing some time ago that a well-known professor was accumulating material for a book on "dew-ponds," but the work is apparently yet in the future. The manner of their formation, as shown in the book under review, is a distinct contribution to science. There appears every evidence to show that many of the ringed embankments and clusters of artificially-planted trees were connected with the worship of the sun, and this connection might well be worked out thoroughly. We are not sure that the authors have not built up rather much upon little, in seeing the former existence of watch-houses and guard-houses in what are merely depressions in the ground. That the Romans utilised the embankments in many instances we have evidence in the tiles and other remains which have been discovered on the sites. We have doubts as to the amount of protection which the embankments gave to men and cattle from wolves or human enemies. They would serve to conceal their occupants, but would they not also serve to conceal the enemy, whatever it was, when it came? In some cases the earth-walls would be far more serviceable in protecting half-naked men and women from the biting winds which cut across the downs and are practically always blowing. This is frequently overlooked. In conclusion, we would refer to the plate on page 69, and would point out that what look like cattle-tracks may be merely caused by the slipping of clay-with-flints upon the chalk. When overgrown with tufts of grass, this has a tendency to form long terraces, and in the distance these sometimes look like a series of step-like tracks. E. A. M.

Resistance of Air and the Question of Flying, by Arnold Samuelson (Spon); price, 2s. net.—This is a work of considerable value, not so much for the information contained within it as for the suggestions which may be brought to mind on reading it. It is one of the very few books which have been written recently on this subject, and gives in concise form many of the latest theories and facts concerning it. But the reader must not take for granted all the statements here made. Many of them are but opinions held by the author, and not shared by other authorities. In fact, he states: "I dare not expect that the whole world will at once agree with me," although he lays down dogmatic assertions which might easily mislead those anxious to learn. The author is, of course, German, and the main portion of the pamphlet consists of a lecture delivered by him, presumably in Hamburg. It is a pity that the MS. was not looked over by an Englishman, as there are many expressions and sentences which are a little obscure.

Report of the Bureau of American Ethnology, 1900-1901; parts 1 and 2. (Washington: Government Printing Office.).—These splendid volumes, profusely illustrated with coloured and other plates, exhibit a thoroughness of detail and painstaking work such as is seldom seen in these days of hurried production. The report consists chiefly of three "papers," the nature of which may be gathered when we say that the first, "Two Summers' Work in Pueblo Ruins," by Jesse Walter Fewkes, consists of 195 large pages with 122 illustrations in the text, and no less than 70 beautifully-executed full-page plates. The other two papers, "Mayan Calendar Systems," by Cyrus Thomas, and "Hako, a Pawnee Ceremony," by Alice C. Fletcher, are almost as long and complete. The first paper comprises the report of archæological field work conducted at a ruin called Homolobi, near Winslow, Arizona, and later at ruins on the Little Colorado River, and at Chaves Pass and other places. A large number, in all 1824 objects, were collected from the excavations, mostly of a mortuary nature from the cemeteries, about half of which were preserved entire, and many of the others in pieces which could be satisfactorily joined together. These objects include vases and bowls of pottery, shell and stone ornaments, bone implements, matting and basketry, stone implements, &c. The illustrations comprise photographs of ruins and coloured representations of the pottery and other objects. The paper on the "Mayan Calendar Systems" is in continuation of one upon the same subject in the 19th Report, but the investigations at the ruins at Quirigua added much to the subject, the results of which are now given. This account should be of great interest to those investigating the calendar systems and calculation methods of the ancients. The account of the Hako religious ceremony is the result of four years of study in collaboration with an educated Pawnee, and is very complete. Among other items, the songs forming a feature of the ceremony were recorded by graphophone, and the music, transcribed from the cylinders, is here given.

Gas Producers for Power Purposes, by W. A. Tookey (Percival Marshall), price 1s., is a small practical handbook for "purchasers, erectors, and attendants," which should prove most useful to the many persons who may now be included in such a category. Full illustrated descriptions are given of the various methods of generating "Producer" and other gases.

Radium, and all about it, by S. R. Bottone (Whittaker and Co.), price 1s. net, is the second and revised edition of a small book which we reviewed recently. It is satisfactory to see that so much public interest is taken in the subject.

The Trojan Women of Euripides.—Translated into English verse by Gilbert Murray, M.A., LL.D. (George Allen), 2s. net. Copious explanatory notes are added.

Second Stage Magnetism and Electricity.—By R. Wallace Stewart, D. Sc., Lond. (University Tutorial Press). Second edition (re-written and enlarged). This little book is primarily intended for candidates who are preparing for the second stage examination under the Board of Education, and will be found to be a reliable and clear guide for them. Plenty of illustrations are provided. The index is not as complete as it might be, as we notice the absence of the words "accumulator," "secondary battery," "incandescent lamp," "coil," &c., which subjects are, however, well described in the book.

BOOKS RECEIVED.

Ambidexterity, by John Jackson. (Kegan Paul.)

Astronomers of To-day, by Hector Macpherson, Jun. (Gall and Inglis.)

Students' Textbook of Zoology, by Adam Sedgwick. (Swan, Sonnenschein.)

Unbeaten Tracks in Japan, by Isabella L. Bird. (Murray.)

The Hawaiian Archipelago, by Isabella L. Bird (Mrs. Bishop). (Murray.)

Natural History in Zoological Gardens, by F. E. Beddard. (Constable.)

What Do We Know Concerning Electricity? by A. Zimmern. (Methuen.)

Modern Theory of Physical Phenomena, by Augusto Righi. (Macmillan.)

The Electro-magnet. C. R. Underhill. (New York: Van Nostrand.)

Introductory Mathematics, by R. B. Morgan. (Blackie.)

Electro-magnetic Theory of Light, by C. E. Curry, Ph.D. (Macmillan.)

Divine Dual Government, by W. W. Smyth. (H. Marshall.)

Elementary Microscopy, by F. Shillington Scales. (Baillière, Tyndall.)

Moths and Butterflies, by Mary C. Dickerson. (Boston: Ginn.)

Our Stellar Universe, by T. E. Heath. (King, Sell, and Olding.)

Pattern Making, by J. E. Dangerfield. (Dawbarn and Ward.)

Preparatory Course of Geometry, by W. P. Workman and A. C. Cracknell. (Clive.)

Positive Knowledge, by J. Logan Lobley.

Poisonous Plants, by A. Bernard Smith. (Bristol: J. Wright.)

The Harveian Oration, 1904, by Richard Caton, M.D.

Zodiacs and Planispheres, by the Rev. A. B. Grimaldi. (Gall and Inglis.)

Annual Report of the Royal Society of St. George.

The Iron and Steel Magazine. (Boston, Mass.)

Petrol Motors Simply Explained, by T. H. Hawley. (Percival Marshall.)

Photography.

Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

Photographic Photometry.—It may seem to be a very obvious suggestion and a very simple matter, seeing that an increase of brightness of the light that impinges upon a photographic plate, causes an increase in the darkness of the resulting deposit, to use a photographic method for the purpose of comparing the brightness or luminosity, especially of those sources of light that cannot be brought into the laboratory, such, for example, as the heavenly bodies. The fact that the increase in darkness of the deposit is not simply proportional to the increase in brightness of the light (with equal exposure time) is easily overcome by impressing a light-scale on the plate so that this shall be subjected to whatever treatment, as in development, &c., that the other exposed parts receive. A light-scale is nothing more that a series of small patches that have been exposed to a uniform light for different times, generally so that the amount of light impinging on the respective patches is proportional to the simple series, 1, 2, 4, 8, 16, &c. By measuring the opacities of these patches and plotting them against the amounts of light, a curve can be drawn that will show at once the relationship between opacity and light in that particular case. Since writing this, a suggestion has actually been published to determine luminosity by estimating by chemical means the metallic silver produced on a photographic plate by the agency of the lights that it is desired to compare.

Thus far all is easy, and it is at this stage that the thoughtless worker too often leaves off, considering that he has completed his task. It is easy to teach students to measure and to weigh, nothing of its sort is more easy, but the difficulty begins with the consideration of what it is that has been measured or weighed. The student of chemistry weighs things and gives them names, but the things he weighs rarely are what he calls them, and in some cases I have known the material weighed not to contain a vestige of the substance that it was supposed to consist of. And so it is in other work, the whole difficulty is to know what it is that has been dealt with. In investigational work, there is a strong temptation to move along the line of least resistance, and this distinctly is to perfect the methods of measurement. It is only necessary to get a little knowledge and a good instrument maker, to reduce the differences between the results of the repeated measurements of the same thing. But if the thing measured is not what we take it to be, if there is, for example, 10 per cent. of uncertainty here, it is mere deception and waste of time to seek to reduce the 1 per cent. of uncertainty in the method of measurement. I am convinced that in a vast number of cases of very many kinds instrumental perfection is already far beyond what we can do justice to, and that the pressing difficulties are the avoidance of loss, and the more perfect isolation and more truthful recognition of the thing that is measured.

In the example quoted above in response to the suggestion to use a photographic method for comparing light intensities, it is not the brightness of the lights that would be compared, nor is it their activism, nor their radiant energy. It would be nothing whatever more than a certain effect that they could produce upon a certain sensitive surface. If the sensitive surface were varied the results would be different. The old idea that activism could be equally well measured by any chemical change that light can produce, and that the selection of the sensitive substance is a mere matter of convenience, cannot, of course, be maintained, and so far as it remains of use is a testimony to the clumsiness and the want of discrimination of the methods that we employ.

Brightness is essentially a matter of sight, and the eye is therefore the only standard instrument for its measurement. By putting over a sensitive plate a coloured medium so exactly prepared that a continuous spectrum photographed through it on the plate would give a density of deposit truly proportional to the brightness of the spectrum in all its various parts, a combination would be obtained that would give proportional brightnesses if used in the manner already described.

Time Development as Affected by Temperature.—In the March number I made some remarks on the mechanical method of development employed by some, in which the exposed plates are allowed to remain in the developer for a fixed and predetermined time instead of allowing one's judgment to decide when the image is sufficiently dense. I there pointed out what I believe to be the advantages of such "time development." In the March number of the Journal of the Royal Photographic Society is published a paper by Messrs. Ferguson and Howard, in which they suggest that plate makers should give with their plates the times necessary for development at various temperatures with the formula they recommend. For a given pyro. soda formula, which, by the way, has too little sodium sulphite to secure a deposit free from the oxidised products of the pyro., they find that "kodoids" give the same steepness of gradation at 17° C in 6 minutes, as at at 12° C in 7 minutes 25 seconds, or at 7° C in 9 minutes 50 seconds. They describe in detail a method of determining the relationship between time and temperature when the contrast (or "development factor") remains constant.

If makers of plates do this, and photographers, one and all, do as the makers tell them, then photography as an art may gain something in the ways I indicated two months ago, but it will lose an incalculable range of possibilities in the hands of the skilful. It is one thing to use mechanical methods when the balance of advantage appears to be in favour of them, but quite another to seek to supplant all discretion by rigid rules. The case may be compared to the feeding of convicts who have their food weighed out to them, and the work expected of them definitely catalogued. There is much advantage in this exact balancing of work and food; gluttony and starvation are avoided and economy is secured. But we who are not convicts do not weigh our food nor measure our work, and think that on the whole we have reason for believing that our health is rather better for the discretion that we prefer to exercise. We consider that our experience is worth something.

Iron Lightning Conductors.

SIR OLIVER LODGE is reported to have expressed his opinion in favour of iron lightning conductors in preference to copper ones. The former allow the current to flow more gradually and to leak more slowly, while with copper, especially if it be of large diameter, a more sudden effect is produced, which may cause side flashes and do damage. The iron rod may be fused, but only after it has done its work, and it is easily renewed. A lightning conductor should be looked upon as a safety fuse, to be replaced when it has been struck.

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MICROSCOPY

Conducted by F. SHILLINGTON SCALES, F.R.M.S.

Fibrous Constituents of Paper.

(*Concluded from Page* 93.)

ESPARTO fibres are generally finer and much shorter than those of straw. They are smooth and cylindrical, and free from knots. The walls are thick, and the central canal accordingly very small and uniform. The ends of the fibres are generally rounded. The serrated epidermal cells found in straw are also found in esparto, and can scarcely be distinguished from these, but the large, thin-walled parenchyma cells are absent. The esparto leaf, however, bears on its inner surface a number of little hairs or teeth, some of which are nearly always found in papers made from esparto, and which are quite a trustworthy characteristic.

Chemical wood-pulp shows flat, ribbon-like fibres, not unlike cotton, and even at times twisted like the latter, but with unbroken ends. It would take up too much space were I to endeavour to discriminate between the various kinds of wood, such as pine, birch, poplar, etc., but they all show distinct woody characteristics. The pits in pine wood are quite unmistakable, as are the obliquely-placed slit-like pores of birch and poplar.

Mechanical wood has a strongly-marked woody appearance, but the fibres are not properly separated, and the fragmented nature of the material, due to the way the fibres have been torn and wrenched across instead of separated, is quite unmistakable.

It only remains to add that fibres stained with chlor-zinc iodine are, unfortunately, not permanent. Permanent preparations can be stained with benzo-brown with a trace of soda to deepen the colour, washed slightly, and then stained with benzo-azurin without soda, and gently warmed, and will form beautiful and instructive mounts, though the differentiation will not be that of chlor-zinc iodine.

The mounting medium may be water or glycerine and water, but for permanent mounts glycerine is not convenient to use owing to the fact that it will not harden or dry. To get over this difficulty, glycerine jelly may be used with advantage, the fibres being first carefully soaked in water from which the air has been expelled by previous boiling. Even then there is often much trouble with minute air bubbles entangled in the fibres. I have found it quite satisfactory to proceed as follows: The fibres, whether stained or not, after soaking in boiled water, are arranged in the centre of the slide, which is placed upon a brass mounting table. Sufficient glycerine jelly is then added, and, after melting, the cover-glass is placed in position and held lightly in place with the point of a dissecting needle. The glycerine jelly is now heated until it just begins to boil, when the lamp is quickly removed. This disentangles and carries away from beneath the cover-glass any air bubbles. After the glycerine jelly has set it should be cleaned up by dipping the slide in water and wiping it carefully with a rag, and then the cover-glass is surrounded with two coats of gold size. Farrant's solution is also useful, as it is a glycerine mounting medium which hardens at the edges. Canada Balsam is less suitable than glycerine media for mounting fibres. They may also be mounted in water with a little added carbolic acid, enclosed in a thin cell of gold size.

High-power Microscopy.

Mr. J. W. Gordon, F.R.M.S., who has contributed several interesting papers on Microscopical Optics to the Royal Microscopical Society, which have, however, led to some controversy, recently gave an address at the Royal Institution, in which many of his views were summarized in a more popular way and without the mathematical arguments which are necessary to an adequate discussion of such a subject. A résumè will doubtless interest many of the readers of "KNOWLEDGE & SCIENTIFIC NEWS." Mr. Gordon observed that in the exhibition of a microscopic object under high magnifying power there are three stages in which difficulties have to be met and surmounted—(1) In the preparation of the object for exhibition under suitable conditions of illumination; (2) in the representation of the object by means of an image; (3) in the transmission of the image so found in the instrument to the eye of the observer. Professor Wright classified the preparation of objects into colour pictures by means of stains and outline pictures. The method of staining having manifest limitations, Mr. Gordon proceeded to refer to the use of cross-lighting or "dark-ground illumination" in order to show outlines, with especial reference to Dr. Siedentopf's application of this principle to the exhibition of so-called "ultra-microscopical particles." In ruby glass, for instance, the colour is due to minute particles of gold diffused through the glass, so small as to be beyond the powers of the microscope as ordinarily used. By special methods of illumination, however, at right angles with the optical axis of the microscope, and by limiting the plane of such illumination, the particles come into view as diffraction discs. Mr. Gordon then dealt with some experiments of his own, originally suggested by a paper of Lord Rayleigh's, but which were still incomplete, which consisted especially of a method of lighting up the object by means of diffracted light, the principle being explained by a diffraction slit formed by the edges of two knives stuck in a board so that their edges overlapped towards the points, but were about an eighth of an inch apart near the handles. It was with such a piece of apparatus that Sir Isaac Newton worked when he made his first precise recorded observations on the subject of diffracted light. Mr. Gordon referred to the observation of Helmholtz, as far back as 1874, that the limit of useful power in a high-power objective is reached when the lens of the objective is of such focal length that its diameter is rather less than the diameter of the pupil of the eye, and that beyond that point there was no advantage in increasing the magnifying power of the objective, but that further magnification was best obtained by increasing the power of the eyepiece. But this method had also drawbacks owing to the smallness of the emergent pencil of light; such, for instance, as the greater prominence of dust upon the lens or of floating particles in the eye. Mr. Gordon considered that this was responsible for the limitation of magnifying powers at present in use by microscopists to 1500 or 2000 diameters, whilst most good work was done

with magnifications of from 400 to 600—a statement, however, which surely needs some qualification, whatever may be the incidental disadvantages due to high eye-piecing. However, Mr. Gordon's method of getting over the difficulty is by the interposition in the tube of the microscope of a ground-glass screen on which the image is received from the objective, so as to scatter the incident rays of light, the screen being made to oscillate in order to prevent its grain from becoming visible, and so impairing the details of the picture. This picture can then be magnified again by means of a second microscope in place of an ordinary eyepiece, with consequent greatly increased magnification. It may not perhaps be superfluous to remind my readers that the mere magnification of an object, or even the rendering visible of what could not otherwise be seen to be existent, as under Siedentopf's experiment, does not give any optical solution as to its true shape and size. In fact, it has been mathematically proved, and remains true, to quote Lord Rayleigh's own words, "In the microscope there is nothing except lack of light to hinder the visibility of an object however small. But if its dimensions be much less than half a wave-length, it can only be seen as a whole, and its parts cannot be distinctly separated, although in cases near the border-line some inference may possibly be founded upon experience of what appearances are presented in various cases. . . . What has been said about a luminous point applies equally to a luminous *line*. If bright enough it will be visible, however narrow; but if the real width be much less than the half wave-length, the apparent width will be illusory."

Royal Microscopical Society.

March 15th, at 20, Hanover Square, Mr. A. D. Michael, F.L.S., in the chair. Mr. J. E. Stead delivered the second part of his lecture on micro-metallurgy, entitled "A review of the work done by metallographers," illustrated by lantern slides supplied by prominent authorities in several countries. Over 120 slides were shown on the screen by means of the epidiascope, and were accompanied by explanations and comments by the lecturer. The series commenced with the earliest work of Dr. Sorby, followed by illustrations of the microscopic characters of iron and steel, silver, lead, copper, tin, and antimony. Illustrations were also shown of the changes produced in metals by strains, a diagram of the apparatus by which rapid reversals of strains were effected being exhibited in illustration of this portion of the subject. The effect of continued heating of an alloy of copper and tin in boiling mercury and also that produced by immersion in liquid air were demonstrated. Slides were also shown to illustrate "surface flow" in antimony, and the microscopic structure of the new silver standard. The following were elected as Honorary Fellows of the Society: Prof. Wm. Gilson Farlow, Prof. Herbert S. Jennings, Prof. Edmund B. Wilson, and Prof. R. W. Wood.

Notes and Queries.

Bausch and Lamb's New Catalogue.

Messrs. A. E. Staley and Co., of 19, Thavies Inn, Holborn Circus, E.C., have sent me the new illustrated catalogue and revised price list of the Bausch and Lamb Optical Company, of Rochester, New York. The illustrations, most beautifully reproduced, make the catalogue quite a work of art. I understand that it will be sent to any applicant on receipt of three stamps to cover postage.

Miss Frances Elliott (*Staines*).—Crystals of lead nitrate would be best shown by polarized light. Asbestos can be shown by reflected light with a low power; geological slides should generally be thin enough to be shown by transmitted light. A binocular would exhibit all these very well. I should strongly recommend you to lose no time in beginning to make your own slides—until you do this you can scarcely consider yourself as having started microscopical work, and you will not only find the work most interesting, but will feel your interest deepened in many ways. In the meantime dissect as much as you can, so as to find out for yourself all you possibly can about the object you are studying, and read it up at the same time. It is of the utmost importance to get an interest in some definite line of study, and to endeavour to master the subject. Pond life is most fascinating and teaches one many things both in zoology and botany, and the present is a very good time to begin. Ready prepared slides have, of course, an undoubted educational interest, but they are not to be compared in this respect with work done by oneself, especially if it is the outcome of a definite aim.

Alfred Goldsbury (*Maxwelltown, N.Z.*).—It is quite common to find parasites in insects such as you describe, but the information you give does not allow me to say more. The ova also are in quite the usual place. If you want any further information please send the slides themselves—they will be duly returned if you wish it.

A. H. Glaister (*Darlington*).—A 1-12 inch immersion of N.A. 1·25, such as you possess, will readily resolve *Amphipleura pellucida*, and the Watson universal condenser is quite suitable, but there is no advantage in using the latter in oil contact as its aperture does not exceed 1·0 N.A. You say, however, that your objective is corrected for the short tube, and it must therefore be used with the short tube only. I think if you carefully carry out the instructions I gave in "KNOWLEDGE" for November last (page 279), you should have no difficulty in resolving the diatom by means of oblique light, especially if it is mounted in a medium of so high a refractive index as realgar. The resolution by means of axial illumination is less easy; it is best shown by carefully focussing the edge of the lamp flame with the condenser and then slightly racking the condenser up within its focus. Are you sure that your objective is clean and free from oil on the front lens behind as well as in front? Human blood corpuscles may be classified as follows: Red corpuscles, which appear yellow when looked at singly, and white corpuscles. The red corpuscles are circular discs, thicker at the sides than in the centre, about 7·5 μ wide and 1·6 μ thick (μ = ·001 millimetre) and without nuclei. The white corpuscles are much less numerous (about 1 in 500). They are nucleated and are classified according to the shape of this nucleus and their affinity for certain stains, but they vary somewhat. They are known as leucocytes, and those which take up foreign particles are phagocyctes. Those which stain with basic dyes such as methylene blue are known as basophil, whilst those which stain with acid dyes such as eosin are termed eosinophil. A very general classification of the white corpuscles is polymorphous, with lobed, or multipartite nuclei; lymphocytes, with large nucleus and little protoplasm; hyaline, with somewhat similar nucleus, but more surrounding protoplasm; eosinophil, with large granules staining deeply with eosin; and basophil, staining with methylene blue.

E. G. W. (*Hull*).—Many objects, especially botanical subjects, can be cut quite satisfactorily by hand. The object is held between the finger and thumb, the index finger being curved round the tip of the thumb and held horizontally so as to form a support for the razor. The object may be held in a piece of pith or even cork. Inexpensive hand microtomes can be purchased from any of the instrument makers if necessary, and in these the object is wedged with pith or cork, or in a piece of carrot. The knife should be drawn steadily from heel to toe with a drawing or slicing movement, the cut being towards one. It should be dipped frequently in water or spirit and water, and effort should be made to cut thin sections rather than complete ones. Most objects cut much better if previously hardened in methylated spirit.

[*Communications and enquiries on Microscopical matters are invited, and should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge.*]

XUM

The Face of the Sky for May.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 4.36, and sets at 7.20; on the 31st he rises at 3.52, and sets at 8.3.

Sunspots and faculæ may be observed on the solar disc on any clear day, whilst spectroscopic observations usually show conspicuous prominences on the limb. For locating the positions of spots, &c., with respect to the Sun's axis, the required data is as follows :—

Date.	Axis inclined from N. point.	Equator N. of Centre of disc.
May 1 ..	24° 18′ W.	4° 3′
,, 11 ..	22° 8′ W.	2° 59′
,, 21 ..	19° 21′ W.	1° 50′
,, 31 ..	15° 56′ W.	0° 39′

THE MOON :—

Date.	Phases.	H. M.
May 4 ..	● New Moon	3 50 p.m.
,, 12 ..	☽ First Quarter	6 46 a.m.
,, 18 ..	○ Full Moon	9 36 p.m.
,, 26 ..	☾ Last Quarter	2 50 a.m.

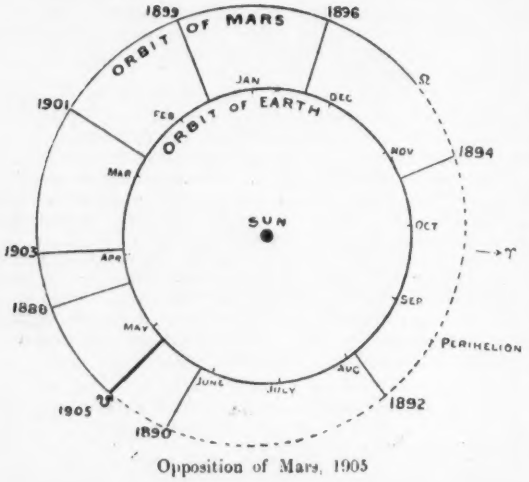
OCCULTATIONS.—The following occultations of the brighter stars are visible at Greenwich :—

Date.	Star's Name.	Magnitude.	Disappearance.			Reappearance.			Moon's Age.
			Mean Time.	Angle from N. point	Angle from Vertex.	Mean Time.	Angle from N. point.	Angle from Vertex.	
			p.m.			p.m.			d. h.
May 6..	α Tauri ..	1·1	5.28	63°	24°	6.30	287°	246°	2 2
,, 12..	A Leonis ..	4·6	8.46	124°	99°	9.53	279°	245°	8 5
,, 13..	c Leonis ..	5·1	7.26	136°	137°	8.34	272°	258°	9 3
,, 15..	38 Virginis ..	6·2	8.30	191°	200°	8.48	220°	226°	11 4
						a.m.			
,, 15..	k Virginis ..	5·9	11.30	76°	54°	0.24	329°	500°	11 8

THE PLANETS.—Mercury is a morning star in Aries, and is at greatest westerly elongation of 25° 26′ on the 21st, when he rises at 3.26 a.m.

Venus is also a morning star in Aries, rising about 3 a.m. near the middle of the month.

Mars is a conspicuous object in the evening sky, looking S.E. and rather low down. The planet is now at a favourable point for observation, as he is in opposition to the Sun on the 8th.



Opposition of Mars, 1905

The present opposition is more favourable than that of 1903, in that we approach nearer the planet by some 9 millions of miles, the apparent diameter of the planet now being 17″·2, as compared with 14″·6 in 1903. The position of the planet in the sky, however, is more unfavourable for these latitudes, since the meridian altitude is 17° lower than at the last opposition. As will be seen from the appended diagram, the present opposition is not the most favourable since the distance of the planet from the Earth is 50 millions of miles, whilst under the best conditions the distance is only 35 million miles.

The latitude of the centre of the planet's disc is + 15°. Thus the northern hemisphere is presented to us. The season on Mars corresponds to our August. On the 1st the planet rises at 8.3 p.m. and on the 31st at 5.15 p.m.

It is interesting to note that the Earth and Moon as seen from Mars will appear to transit across the Sun's disc on May 8, since the planet happens to be near the descending node. The last two transits occurred in 1879 and 1800 at the other node. The next will be in 1984.

According to Mr. Crommelin the diagram below represents the transit of the Earth and Moon as seen from Mars, across the Solar disc.

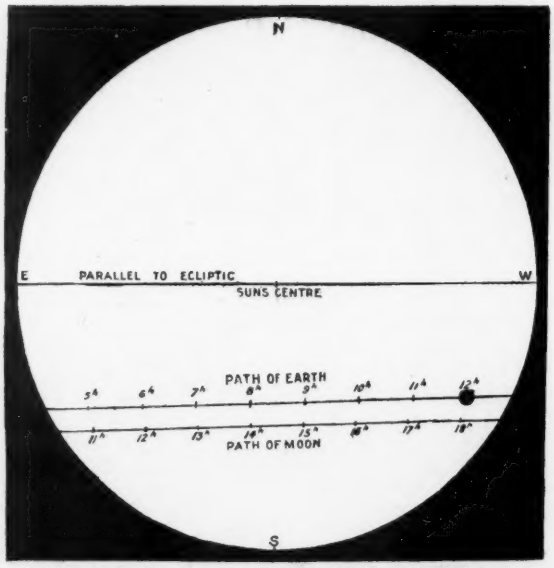


Diagram showing Transit of Earth and Moon as seen from Mars, May 8.

The beginning and end of the Earth's transit across the Sun's disc will be 4.10 p.m. on the 8th and 0.52 a.m. on the 9th respectively, hence owing to the absolute symmetry of the illumination of the planet between these times, it will be a favourable opportunity for measuring the diameter and polar compression of Mars.

Jupiter is invisible, being in conjunction with the Sun on the 4th.

Saturn is a morning star in Aquarius, rising about 2 a.m. near the middle of the month.

Uranus is situated in Sagittarius, and rises about 11 p.m. on the 15th.

Neptune appears in proximity to the star μ Geminorum, but it is now getting well to the west, and sets about 11 p.m. near the middle of the month.

METEORS.—The principal shower during May is the *Aquarids*. This may be looked for between May 1-6; the radiant being in R.A. 22 h. 32 m. Dec. S. 2°., near the star η Aquarii.